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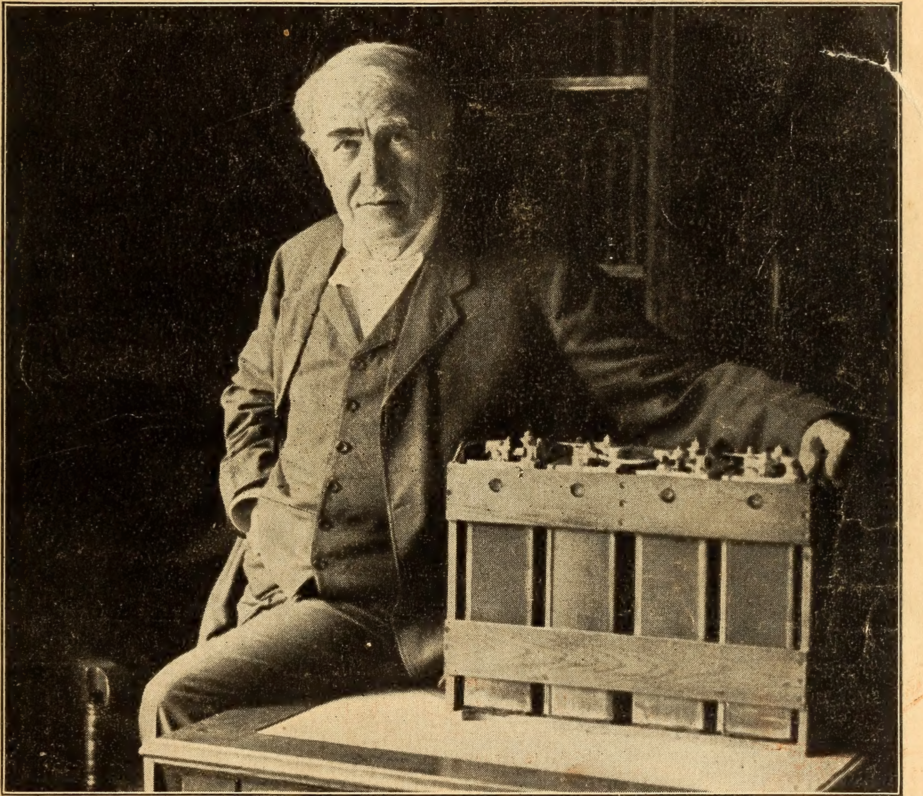

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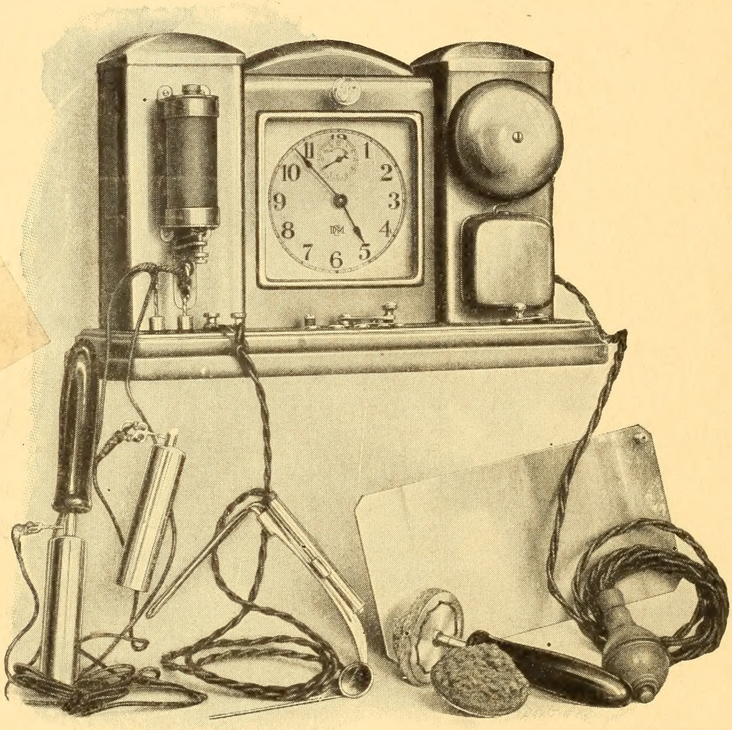

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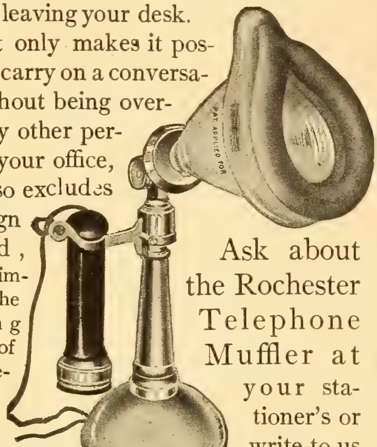

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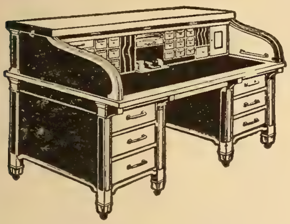

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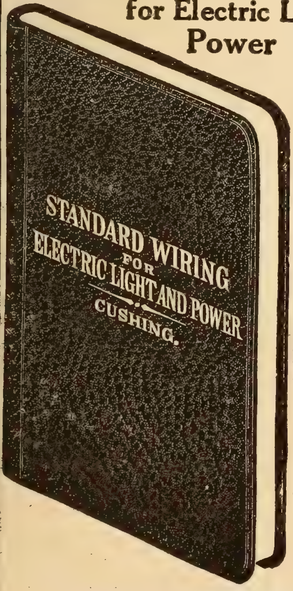

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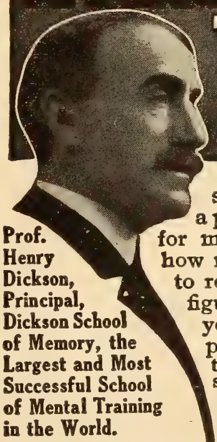

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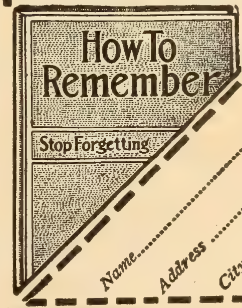

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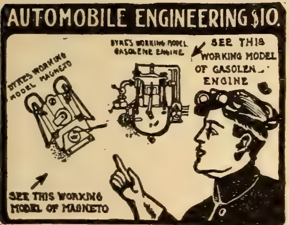
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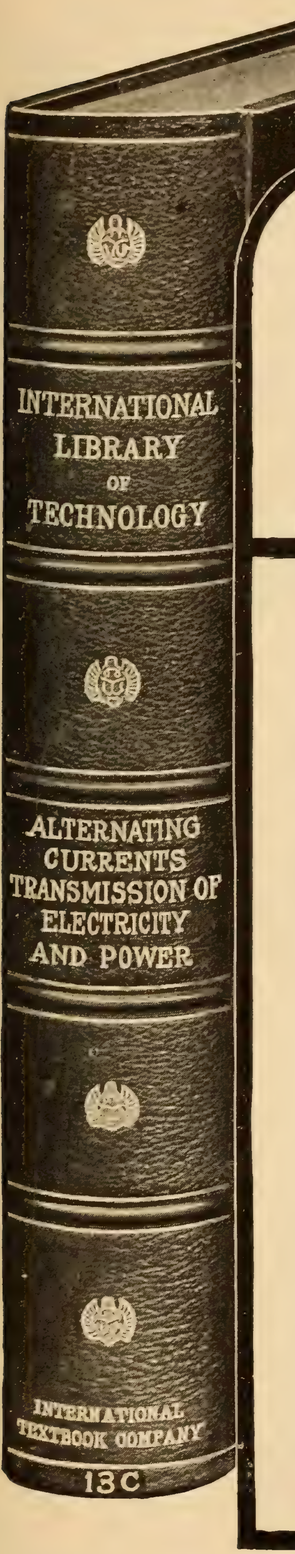

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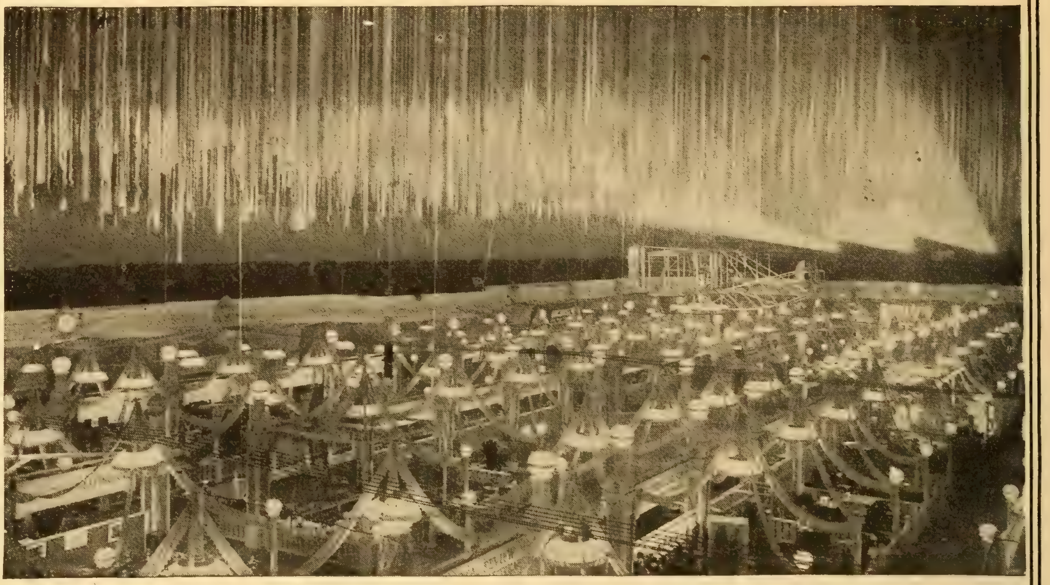

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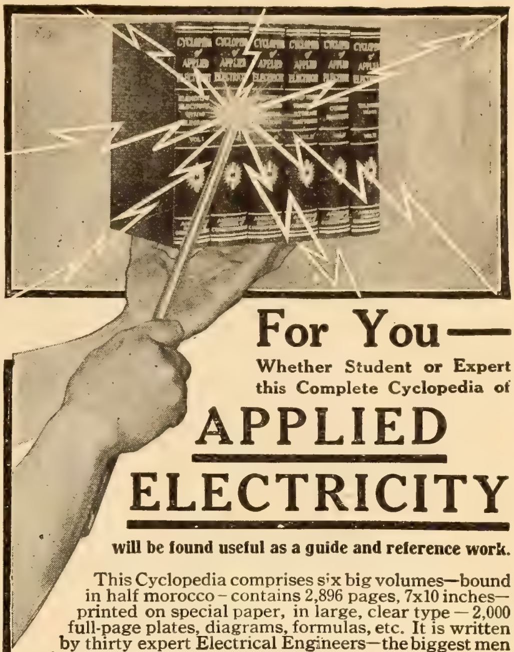

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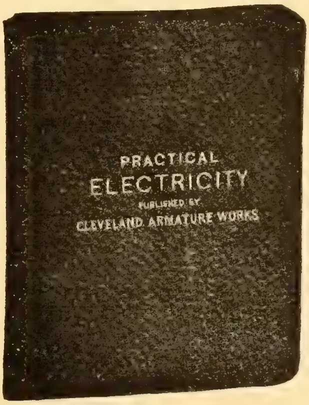

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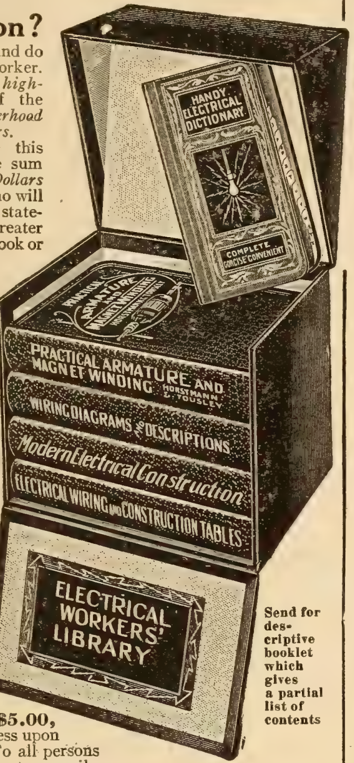
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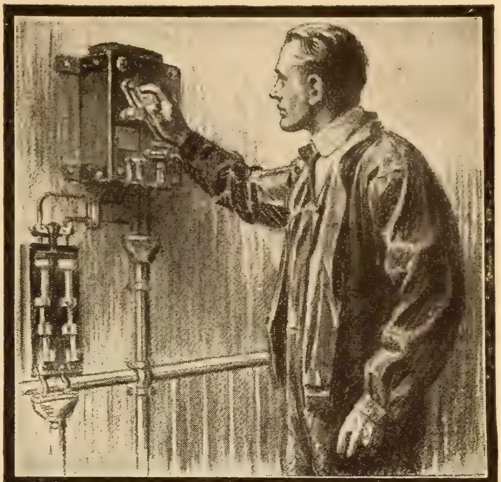

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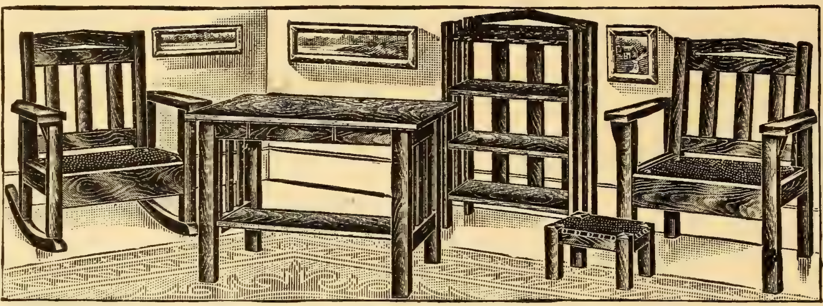

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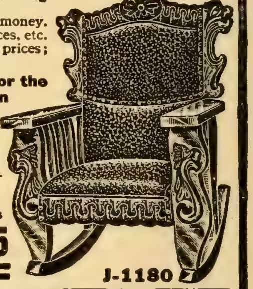

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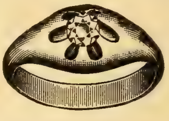

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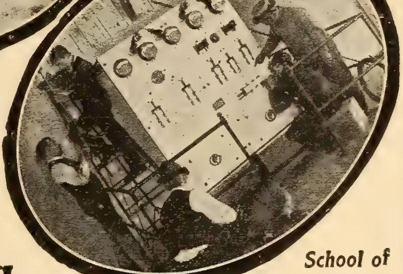

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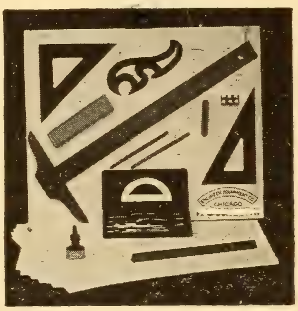

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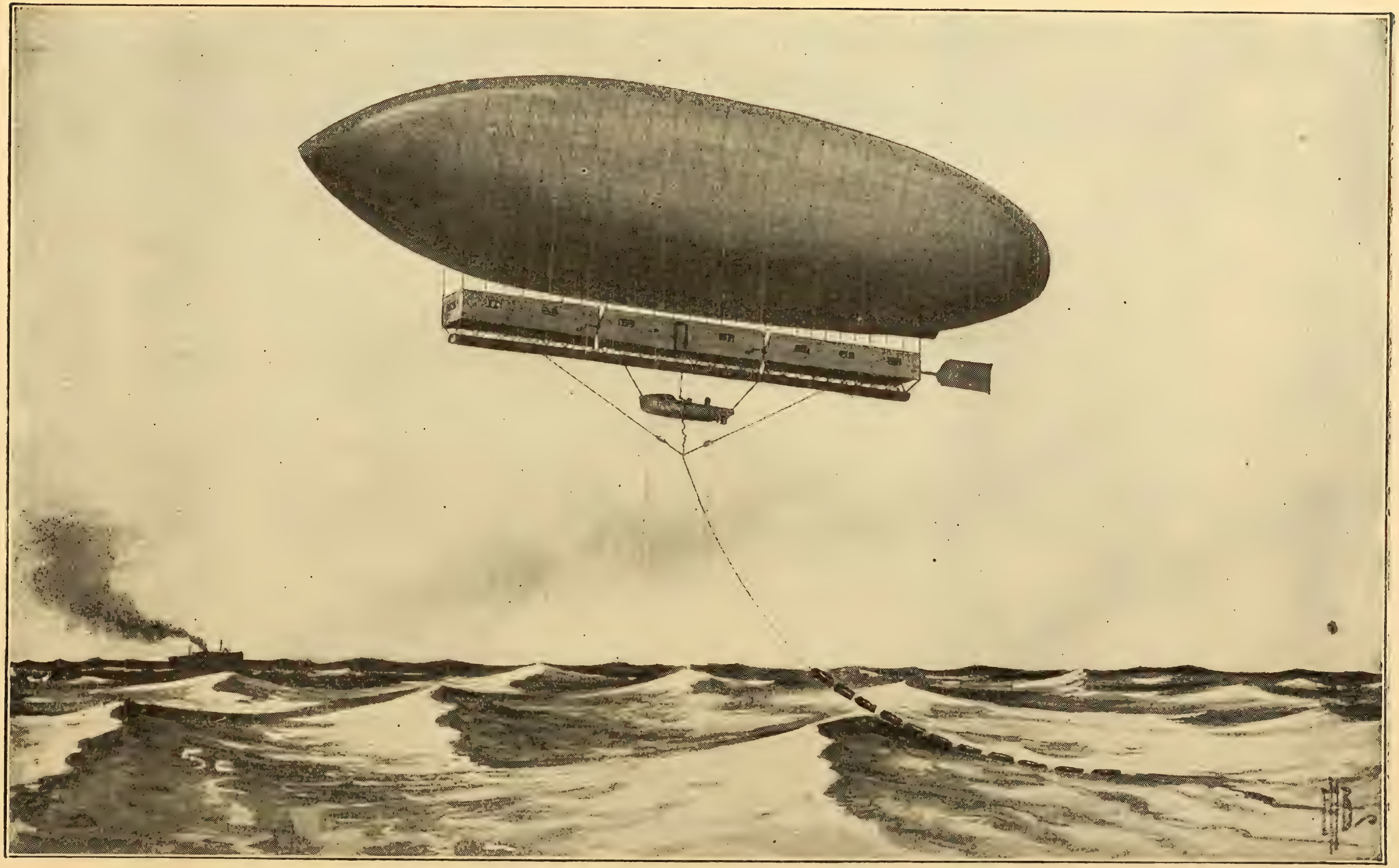

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VOL. III NOVEMBER 1910 No. 7

Edison Tells of His New Battery

Editorial Note.—The article which follows is based on an interview with Thomas A. Edison secured for Popular Electricity by Mr. C. V. Tevis In this interview Mr. Edison consented to explain, in the terse but interesting way in which he always expresses himself, how he came to invent the storage battery which bears his name.

Nine years ago there was begun the working out of an idea which had been long incubating in a master mind. Within a few months its feasibility had been demonstrated; within two years it was a completed and successfully working mechanism. But the master was not satisfied, and back to the shop it went. Another year and another, until six had passed—and the idea remained to the public but an idea. Then one day it re-appeared.

After nine thousand experiments, a thousand to a year, Thomas A. Edison finally said, "It is finished"; and his storage battery was given to the world.

"The Wizard's Pet" is what those who work in the great Edison laboratories in Orange, N. J., call this latest product of his brain, and the inventor does not deny the allegation. Since the production of the electric lamp, Mr. Edison has done nothing that has so satisfied him. And the possibilities of the storage battery which continued experiments are making plain to him are such that the result of the nine long years of labor promises to be the crowning achievement of the great inventor's life work.

Mr. Edison consented to explain his new marvel.

"It's a simple thing, isn't it?" he said, as he took from a rectangular can two slides each about fourteen inches long and five wide. One was covered with little corrugated pockets and the other looked like a tray of steel lead pencils. There were five of one and four of the other, in the can.

"That is all there is to the battery, with the exception of water and a little caustic potash. This is one complete cell. I can run a big truck a mile or an ordinary sized vehicle four miles with this and nothing else. And for the next ten or fifteen years I can use the same cell. Pretty good battery, don't you think?

"That is what people are finding out, at any rate. Since I put it on the market less than a year ago it has been remarkably successful. We cannot fill orders fast enough now. Big mercantile houses in New York, Chicago and several other of the large cities are using the batteries on their wagons altogether. Express companies, railroads, steamship lines, factories, all sorts and sizes of industries, have the battery on trucks, wagons, small cars, etc. It is more than making good.

"The problem of traffic, a most important one in this day, is being solved beyond a doubt. This matter first caused me to start work on better, cheaper, more reliable locomotion. I took a trip about New York. From the Battery up to Forty-second Street we were stalled many times. I got out of my automobile and, standing on corners, counted and timed different kinds of vehicles. I even followed one truck from the minute it left a wholesale house on its way to a pier until it finally returned. The speed of the truck was one mile in one hour and a half. From these investigations I found that while fifteen years ago a truck could make seven trips for the house, today it can make only four, and within ten years it will have a hard time to make two, if conditions are not bettered.

"I began work at once on my battery. What I perfected costs very much less than the old lead battery. It weighs just one-half as much and gives twice as much speed. Already there is very evident relief from traffic congestions in many places where the battery has been widely adopted. Give me a few years more and I'll show the last of the horse in the cities. I'll show clean streets and noiseless business districts. I'll show a doubled amount of business for less cost than the present volume.

"But that is only one phase of usefulness of the battery. We are experimenting with it in all sorts of small boats, as a system of car lighting, as a sparking battery, in locomotives, in coal mines, on dock trucks, in every conceivable way. Why, I even can work all the farms in the country with it.

"Its use on a rotary plow is now being worked out. On all farming implements, however, it will be as practical. All that is needed is a ten-horse-power windmill to generate and store the power, then the agriculturist will not really have to work, as he calls work now. He may sit at a switchboard and read his paper a good part of the time. Give him windmills and storage batteries and he will work harder cutting coupons than he will in his corn fields.

"When he can get a battery for from $200 to $600 which will last him for many years, there will be a considerable saving to him in the way of help. The farmers in the West are always short handed now, and the men they do get they have to pay big wages. This eats into their profits to a considerable extent. Anybody can run one of the batteries; the farmer would not have to employ skilled workmen.

"The weight of the battery is about all there is that is holding us back from doing almost anything with it. The battery that I say will go 100 miles on one charge weighs with the wagon, a ton and a quarter. You could not very well carry one of this size in an aeroplane, for instance. But it is just to such ends that we are hard at work. I have no doubt whatever that before very long we will have devised and perfected a high power, durable battery that will weigh no more than a gasoline engine. The business of flying will then be a much safer one, because my electric storage battery is reliable.

"It was, indeed, the fact of the unreliability of gasoline and gasoline engines that convinced me early that electric power was what I must utilize; that a storage battery instead of a motor was what I must invent. A street car company could put gasoline power to its cars for a few hundred thousands, but it dares not take the chance. It prefers to spend several millions for an electric service to being bothered with all the break downs, stalls and repairs of the complicated gasoline engine mechanism. In the long run the gasoline would be as expensive as the electricity, and exceedingly more troublesome.

"In my battery the active materials are oxides of nickel and of iron, respectively, in the positive and negative electrodes; the electrolyte, the liquid in which the electrodes are immersed, being a solution of caustic potash in water. The retaining cans are of sheet metal, electro-plated with nickel, fused so that they are practically one metal. The battery is almost unlimited in life. As only the water in the potash solution evaporates, so only water need be added to keep the electrolyte in the right condition.

"There are no acid fumes to destroy the iron work of a truck or wagon and eat it away, as in the old styled batteries where sulphuric acid is used. For the same output the battery weighs about half as much as a lead battery and, in addition to this, it will save about 50 per cent of its weight in the construction of the truck itself. It cannot be injured by overcharging, does not deteriorate when left discharged, offers accessibility to each cell, makes it possible

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for any cell to be removed and gives nearly twice the output of mileage of a lead battery of the same weight.

"Keep the water in it and it will do the work, today, next month, in five years from now. There are no repairs to be made; as it doesn't get out of repair it always goes.

"I have just received a number of reports from firms of wagon, truck and pleasure vehicles. Here is one: 'Wagon A—weight with battery one and one-quarter tons; 132.5 miles on one charge; manufacturer's guarantee, 100 miles.' And another: 'Wagon C—weight 100 pounds less than A; 146 miles on one charge; manufacturer's guarantee, 100.' These figures speak for themselves.

"Two months ago one of the big firms in New York made a test of one of their trucks which I had equipped with storage batteries. They found it 50 per cent higher than I had rated it. This truck has the longest delivery route in the city, making 63 miles every day. At the time of the test it had just completed 1,500 miles.

"The storage battery street car, which was put in experimental operation on the Twenty-eighth Street line in New York this year, is another striking efficiency proof. At an expense of about 35 cents a day this car is kept in continual service. Its batteries are good for many years, too, and there is never any chance of it getting stalled or out of repair, so long as a little water is freely used every day.

"In this last particular the advantage of this car over the others using electricity is plainly to be seen; traffic in all the big cities is going to double in the next few years and the problem of public transportation will become very complicated. More lines will have to be built and all this additional hauling will necessitate the erection of more power houses at enormous expense. Even then the uncertainty of a short circuit, or some trouble in the plant, of a dozen or more contingencies, will work against the service, just as it does today.

"With my batteries, as I have said, there is no chance of a delay for any reason. There would be no stalled cars. And—this is the biggest feature—it would not be necessary to erect any new power plants. Those that are now busy but one-half of the time in 24 hours could be utilized on double time. While the great number of the cars were in the shops at night their batteries could be recharged. This would last them throughout the next day.

"I feel sure that we have solved the problem of cheap, reliable power. There is really no end to the uses of it.

"The upkeep is very inexpensive; the batteries consume nothing while idle; they have a longer life than a horse; they provide more speed and need no rest; they do not balk at any sort of weather.

"I did not get my battery just where I wanted it without hard pulling, I tell you. It was like the electric light, only 'never giving up' got the result. The patience required to make the experiments and tests necessary was enormous.

"Two of the best men I had gave it up in despair and resigned. They were paid good salaries, but the work got upon their nerves. They were like the man who was employed to carry a brick from one spot to another—it was easy work, but he went crazy, almost, before he had completed his task. It was the same with the storage battery experiments. Night and day, never stopping, we kept at it for many years. And we finally won.

"Just imagine the picture. The rattle and jar of heavy traffic in the cities all hushed—towns on rubber tires; little or no dirt in the streets; no congestion and delay at the busy corners; speed, safe and reliable, in the vehicles carrying on the day commerce; then the farm lands—windmill tilled—where after half of his former day's work, the farmer joins his family, free of care by reason of his silent, electrical helper.

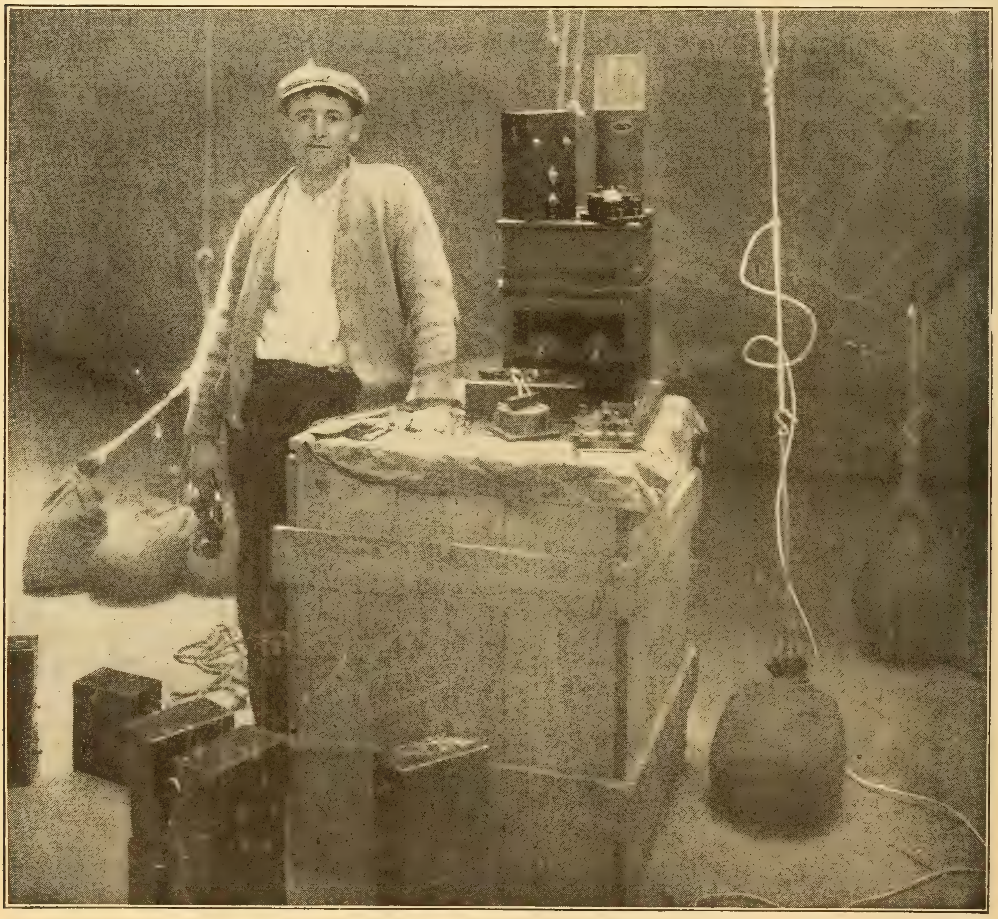
"I am sure that all of these pictures are quite faithful to the future. Cheap power will paint them. And I have furnished that."

Across the Atlantic by Airship

By F. M. SAMMIS, Chief Engineer of the Marconi Wireless Telegraph Company of America

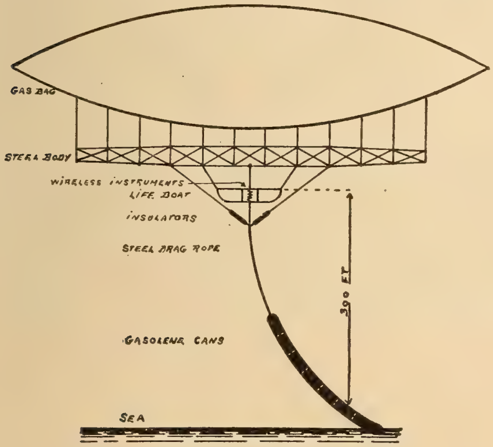
As this issue of Popular Electricity goes to press an interesting and daring experiment is about to be made by a party of men headed by Walter Wellman, the well known balloonist. This experiment is nothing less than an endeavor to pilot a dirigible balloon of the latest type across three thousand miles of the Atlantic Ocean. While the object of this article is primarily a description of the wireless equipment on this great airship, it may be of interest to turn aside for a few minutes in order to give some idea of the expedition in general and the apparatus employed in fitting out the airship.

At Atlantic City, N. J., there has been erected a large shed or aerodome in which is housed the great dirigible balloon that perhaps is destined to mark a new era in the conquering of the air. The huge balloon is a masterpiece of strength attained with minimum weight. In order to provide even the essentials of possible success for this expedition it was necessary that the balloon should have immense lifting capacity, consequently the cigar-shaped envelope was constructed so as to have a total gas capacity of 345,000 cubic feet. Hydrogen gas, being twelve times lighter than air, the lifting force



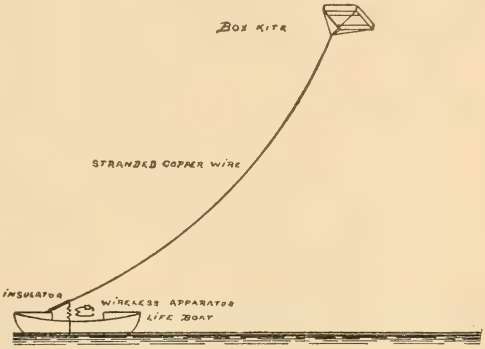
OPERATOR IRWIN OVERHAULING THE WIRELESS APPARATUS IN THE BALLOON SHED AT ATLANTIC CITY is therefore the difference between the total weight of the gas and the weight of a similar quantity of air, or 23,650 pounds. To the lay mind this would seem ample, but the grand total weight of machinery necessary for the driving of this aerial craft at the speed of 25 miles an hour, together with the enormous supply of gasoline, provisions, etc., to say nothing of the life boat and its emergency outfit, was so great that it was found necessary to reduce to a minimum all these parts, in order to keep within the required limit. The gas for filling the balloon is generated by combining 80 tons of sulphuric acid with some 60 tons of iron turnings. It is expected that once the envelope is filled the gas will be so perfectly contained as to last the entire voyage.

Contrary to the natural assumption, the problem is not so much to maintain sufficient lifting capacity, and therefore keep the balloon up, as to so regulate the lifting power as to keep the balloon down. Gasoline and supplies will be used up at the rate of 50 pounds per hour while the lifting power of the gas bag remains constant. It will thus be seen that some provision must be made to equalize these forces. The man in the street would say, "Why not let out some of the gas?" But while this seems logical, it is impracticable for the reason that any reduction in the amount of gas in the envelope below its full capacity would immediately weaken its backbone and destroy its normally rigid cigar shape.



SHOWING THE DIRIGIBLE WITH ITS "DRAG"

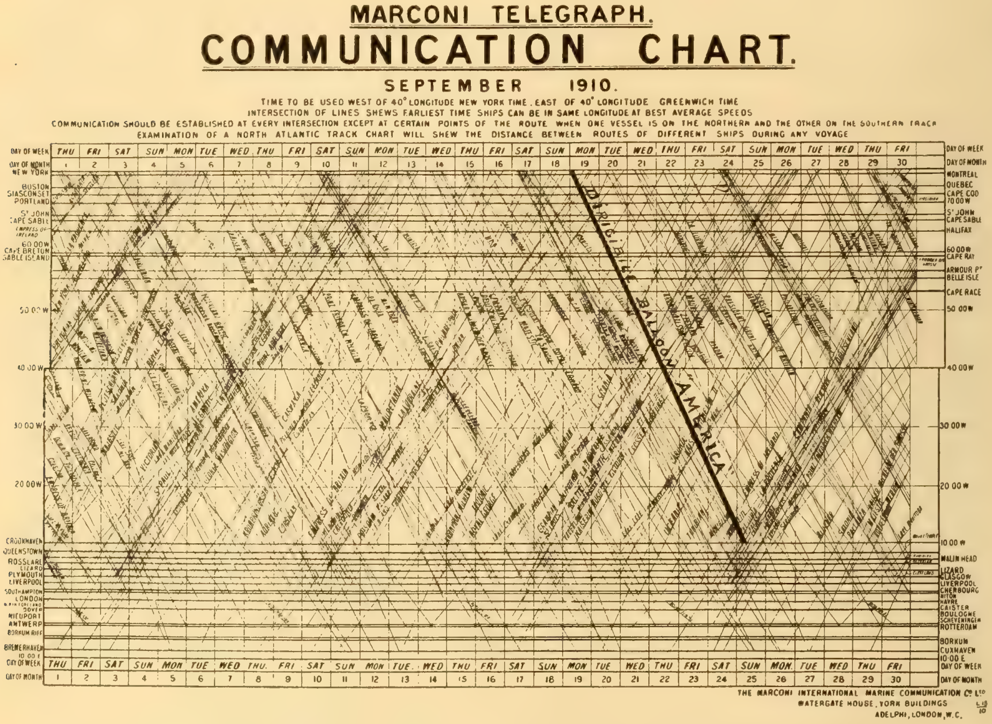
Two devices have been provided to overcome this very considerable difficulty, one of which is called an equilibrator. This device is a steel cable some 40 feet long, over which are slipped some 30 gasoline cans of special design, each having a capacity of approximately a barrel of gasoline. This equilibrator, more commonly termed a drag rope, is suspended from the body of the car, as shown in the diagram and in the frontispiece, by special insulators, the purpose of the insulators being to allow the wireless apparatus to be electrically connected in between the steel frame and the drag rope. Since the lifting power of the hydrogen gas is a variable quantity, depending upon the effect of sunlight or the lack of it, the balloon rises correspondingly, and the drag rope therefore is lifted more or less out of the ocean through which it trails, thus balancing to a very fair degree the lifting power of the gas bag.



HOW WIRELESS MESSAGES COULD BE SENT FROM THE LIFE BOAT

Still another device is provided in order to preserve the rigid nature of the balloon should it become necessary to release some of the gas or should any considerable amount be lost by leakage. This device is nothing more than a sort of pocket or second balloon contained within the first. This second and smaller compartment may [be filled with air and as the section containing the gas becomes more or less expanded, the second compartment may be more or less filled with air by means of auxiliary pumps and exhaust valves.

Suspended from the balloon by means of manila ropes and steel wire is a long tubular steel frame braced and counter braced with slender steel rods and turn buckles. The main body of this steel frame consists of a tank running its entire length, made of riveted sheet steel, and in this the main supply of gasoline is carried. The tubular steel frame above referred to is bolted to this tank in much the same manner as the ribs of a vessel are fastened to the keel and at one end is placed a great rudder built up of canvas on a tubular steel frame. This rudder is used in the same manner as a ship's helm, while two especially designed propellers, driven by one of the main engines, are so arranged that their plane may be tilted so as to cause the craft to rise or descend. Underneath the tubular steel car is swung an unsinkable life boat stored with supplies for 30 days. This little craft is a marvel of lightness, weighing less than 1,000 pounds.



THE ATLANTIC IS CRISS-CROSSED WITH LINES ALONG WHICH WIRELESS COMMUNICATION IS NOW POSSIBLE

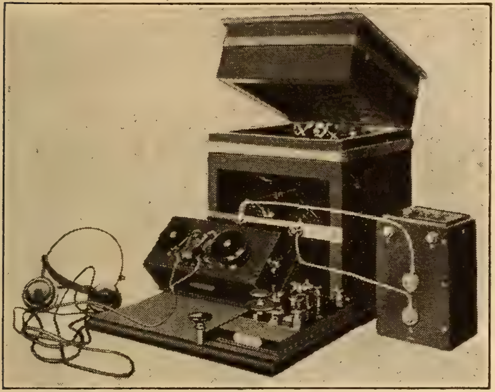
The motive power of the airship will be two four-cylinder gasoline engines developing 80 horse-power apiece, each engine driving a pair of wooden propellers eight feet in diameter. A smaller engine is also provided for auxiliary work.

The crew will consist of six men all told, including the wireless operator. Canvas bunks have been arranged along either side of the steel frame of the car to provide resting places for the crew during the long voyage.

It is expected that if the favorable trade winds are encountered that are prevalent at this time of year, the crossing of the Atlantic will be accomplished in five or six days, and even though ideal conditions may not exist after the start is made, it is expected that the airship will be able to stay aloft for a much greater period of time than this.

While the prime object of this expedition is the crossing of the Atlantic Ocean, a not unimportant essential is the sending of news of the expedition to several of the newspapers in New York City, Chicago and London, and the transmission of this news enroute could, of course, be accomplished only by a modern equipment of wireless telegraph apparatus. It was essential that it be Marconi apparatus, owing to the fact that the entire North Atlantic is constantly dotted with ships carrying this type of apparatus. The communication chart here reproduced will give the reader some idea of the extent to which this is true. Upon this chart will also be noted the line designating the course of the airship America, and from which the operator will be able to learn the vessels with which he is likely to communicate. It will be readily understood by the reader that the lines slanting downward from left to right are eastbound ships and the intersecting lines are westbound ships. The section between vertical lines represents 24 hours of time, and the space between horizontal lines ten degrees of longitude, or approximately 600 miles.

By means of these numerous ships the airship America will be able to have retransmitted such news bulletins as may be sent to any one of them. Such news items as are sent, reporting the progress of the airship, its position, rate of speed, etc., will be transmitted directly ashore as long as the balloon remains in touch therewith. But after direct touch is lost the messages will be handled by means of ships carrying more powerful apparatus and within working range of the dirigible.



THE MARCONI WIRELESS EQUIPMENT TO BE CARRIED BY THE "AMERICA"

The route of the airship is practically parallel to the east-bound steamer lane, so that constant communication may be had, and there is also the quite evident advantage of being near this track in case of disaster. In order to show the practicability of the retransmission of daily news messages from the America, the reader will note upon the communication chart all vessels fitted with Marconi apparatus, their positions being shown on any given day.

Since the America is designed to travel at a speed closely approximating that of a modern ocean passenger vessel, it will be readily understood that when the airship starts, she will remain in close company and constant good wireless communication with vessels sailing eastward from New York on the same date, or a day or two previous. There is no reason, should Navigator Wellman desire, why his craft should not be convoyed by any one of the liners sailing on the same date, having a rate of speed similar to that of his own vessel. The communication chart shows the September sailing dates of eight or ten vessels, from which he would have been able to select at least one or two were the start made in September.

The wireless equipment of this balloon is unique in several respects. It was especially designed so that danger from sparking would be negligible. This was important owing to the presence of the huge supply of gasoline, and also of hydrogen gas. Power is supplied from a 24-volt accumulator battery which, in addition to furnishing power for the Marconi equipment, lights the craft by means of incandescent lamps. The wireless instruments have been placed in a forward locker of the life boat. The storage battery is also carried in this compartment. Thus, if it becomes necessary to launch the craft the wireless equipment will be where it will be most useful. The general method of connecting and operating is the standard one with Marconi equipments.

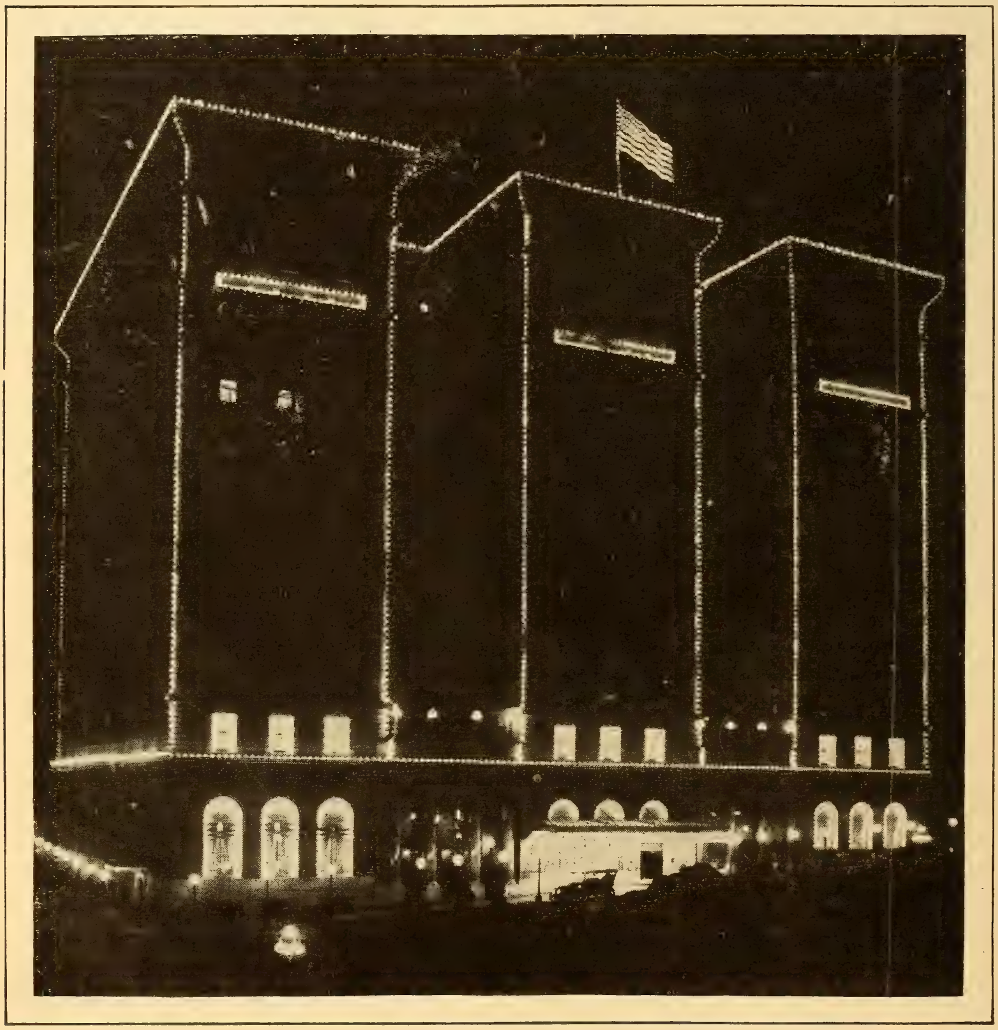
The Marconi Company asked for a volunteer to operate its apparatus on the America, during the transatlantic voyage, and it was immediately swamped with offers from the men of its large staff of operators. Of the many who volunteered J. R. Irwin was considered as possessing the necessary qualifications, and was therefore placed in charge. Mr. Irwin, better known as Jack Irwin, is one of the original C. Q. D. heroes, having received the famous distress call from the sinking Republic, while on duty at the Marconi Station on Nantucket Island.

In order to be prepared for any emergency, Operator Irwin is taking with him a supply of special stranded copper wire and a large kite. Should it become necessary to take to the life boat the kite will be raised, the copper wire being attached in lieu of the cord. The lower end of this wire will be connected to the wireless transmitter in the life boat, as shown in the diagram, and once more a C. Q. D. will be sent broadcast, with its appeal for help.

In Palaces of the "Well-to-Do"

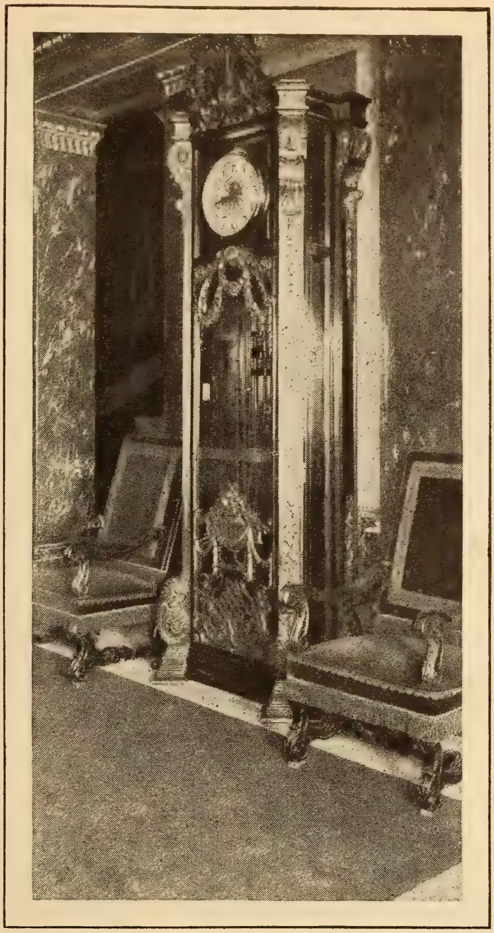
When a millionaire or a near millionaire makes his home in a hotel in these days he is not following out a whim or a fad. Nor is he seeking to build up a reputation for eccentricity. He follows this manner of living because his money will buy him every comfort and every luxury that his senses may crave. His wants are administered to by a retinue of servants that is more than kingly. Almost before a desire is expressed its fulfillment is accomplished. And he may say without stretching the facts: "My home is my palace."

Palace is a term that may well be applied to the modern hotel in a large city, which caters to the best class of trade. While some may seek to obtain the more wealthy of the tourist class there are others adapted to meeting the wants of families who desire to rid themselves of the care of a home and the annoyance attendant upon the direction of a staff of servants. And this acme of perfection in comfort and homelike atmosphere is to all appearances attained alone by the American hotel. Joseph Reichi, manager oi the Alexandria Hotel of Los Angeles,



THE ST. FRANCIS HOTEL, SAN FRANCISCO, AT NIGHT who has just completed a tour of inspection among the leading hostelries of England and the Continent, says: "There are just two hotels in Europe which compare with the best of our American hotels, and these are patterned after American ideas. It is a fact that many of Europe's best hotels still use the old push button system and refuse to install telephones."

In considering such notable hostelries as the Hotel St. Francis of San Francisco and The Blackstone of Chicago, we are brought face to face with the problem of how these immense institutions cater to the wants of their guests with such promptness and without hurry or bustle, for one cannot step inside either of these great buildings without noting their richness and feeling their restfulness.



MASTER CLOCK WHICH OPERATES ALL THE CLOCKS IN THE ST. FRANCIS

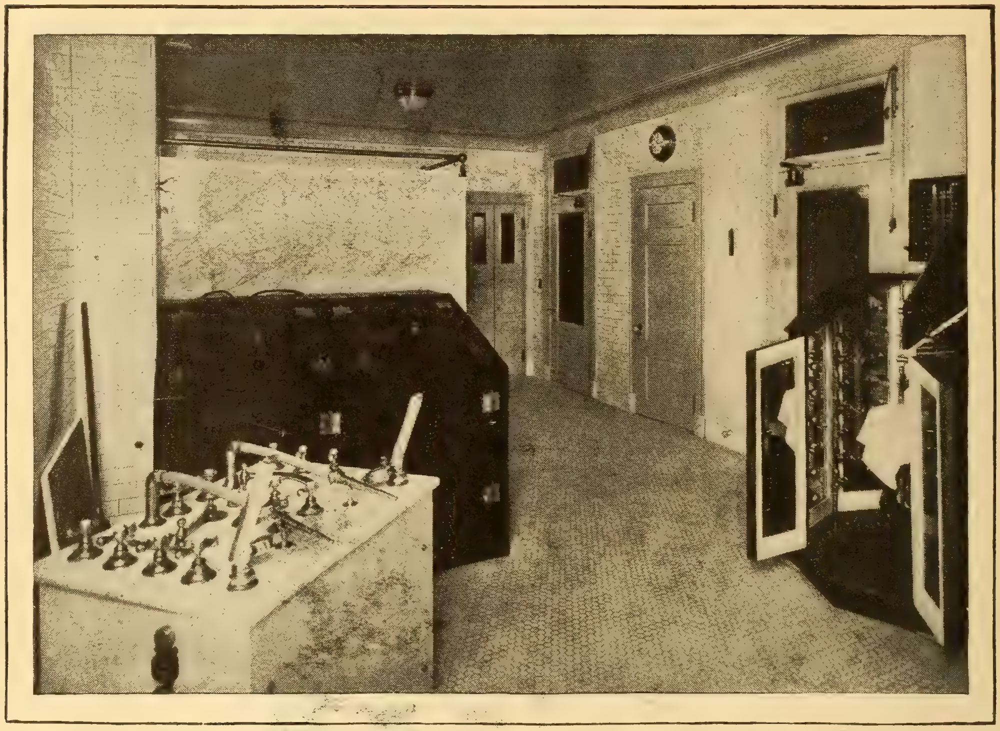
Even the casual observer soon appreciates the fact that electricity is doing every conceivable task that can well be imposed upon it, from lighting the building to making a copy of your message at the clerk's desk on the first floor as you write it on the telautograph on some upper floor.

Located in the heart of the down-town district, yet affording a beautiful panorama of the Bay, Hotel St. Francis symbolizes better than anything else the triumph of San Francisco over adversity, the opening night being just nineteen months after the fire.

There is an old and trite saying that the civilization of a nation may be measured by the amount of soap it uses. Replacing the word "soap" by "electricity," and the proverb applies well to present day industries and institutions. The illumination of the exterior of Hotel St. Francis during a festival or special occasion, the means for doing which is a permanent installation, gives but an inkling of the varied uses of current in the interior.

Entering the lobby, illuminated by massive cut glass electroliers hung from a ceiling of gold and walled by beautiful dark marble, one feels himself in a place of "magnificent distances." Yonder is the cafe with its ceiling patterned after the Chateau Brissac in France, and over here the White and Gold Room with its massive columns like the ball room in a king's palace; then passing through the ladies' reception room we enter the Tapestry Room, wonderful because the greatest mural decorators in America placed within its walls designs representing an outlay of $100,000. One cannot help noting, also, the beautiful clocks placed in the various rooms. Each clock is automatically controlled electrically from a master clock which stands in the lobby. This masterpiece of mechanism was made in Saxony and is said to be the first of its kind in the West.

Those who remember Hotel St. Francis before the fire will be glad to find still looking like the same old place, one spot, the Rathskeller. There are a few changes, of course, and among them the use of an electric grill that cooks a steak in five minutes, which will tickle the palate of the most



HYDRO- AND ELECTRO-THERAPEUTIC BATHS, HOTEL ST. FRANCIS

fastidious of epicures. Located also in the basement is the electric grill room. A display case fitted with a cold storage appliance affords the patrons the unique privilege of choosing the particular article they desire cooked and its preparation requires less than one-half the time which would be taken if coal or gas were employed. Petrified wood was largely used in finishing this room and the lighting fixtures of stag's horns add decidedly to the attractiveness, reminding one of the interior of a hunting lodge.

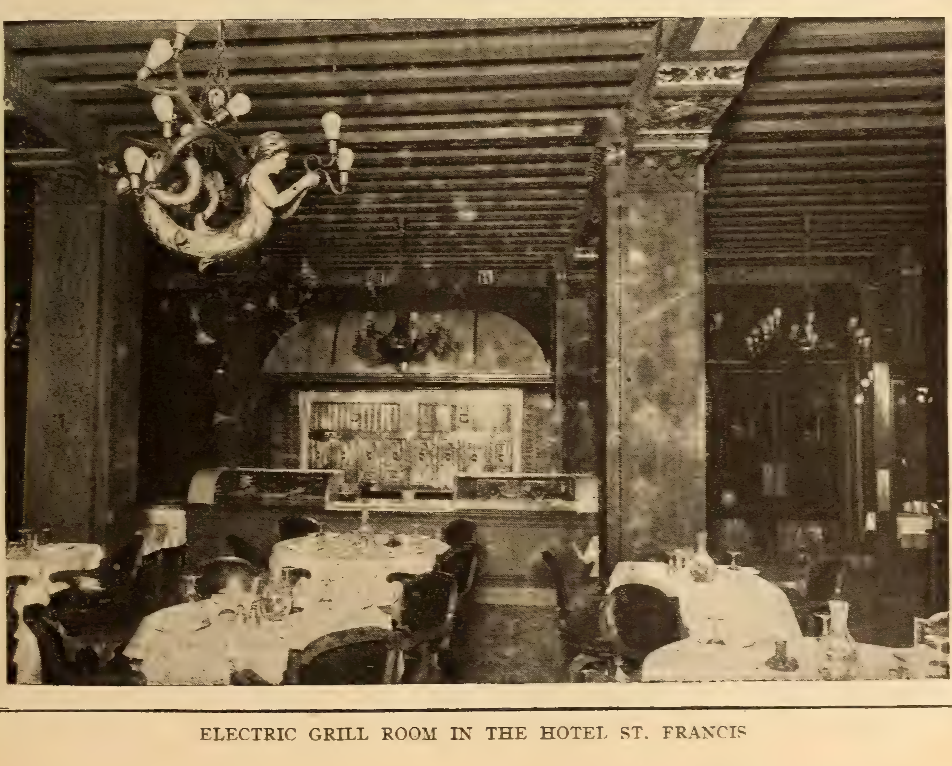
The hotel has its own electric lighting plant with a capacity sufficient to supply 30,000 incandescent lamps. Also its own cold storage, tailor shop and laundry. This latter with a view to light and cleanliness is located on the fourteenth floor. It has a capacity of 40,000 pieces daily and from its washing machines and driers to the ironers is electrically operated.

HOW ELECTRICITY IS USED IN THE LAUNDRY OF THE HOTEL ST. FRANCIS

Mention should also be made of the electro-therapeutic baths, the cabinets of which are finely finished in enamel and heated by incandescent lamps on the interior.

An elaborate pneumatic tube plant aids the management in caring for the 750 rooms and guests with facility. In this plant are over 30 stations of 2¼-inch pneumatic tubes, giving communication between the several departments throughout the building. Lines radiate from a central desk in the main office to each of the cashiers in each of the dining rooms, to the chef, pantry, barber shop, wine room, bar, baggage room, laundry, linen room, steward, as well as a line from the chef and chief operator to each of the floors. This equipment does the work which would otherwise be done by a small army of messengers. The plant can do the work of fifty messengers and do it quickly, noiselessly and efficiently. All portions of the apparatus are concealed in the floors or partitions so that nothing is visible except the ornamental terminals, where carriers are dispatched or received. The plant is operated by a small motor and blower, located in the engine room, and is entirely automatic in its operation, in that the dispatching of a carrier starts the machinery and its discharge from the tube automatically stops the consumption of power.

The Blackstone Hotel has been referred to as "Chicago's Diadem," and the Drake Brothers spared nothing that an expenditure of $3,000,000 would make possible Located on Michigan Avenue, it affords an unobstructed view of the boulevard and Lake Michigan. By daylight the magnificent outside architectural design piled up to a height of 20 stories, yet symmetrical throughout, creates in one an admiration for the engineering skill which made it possible, while at night it offers a picture in exterior electric lighting not soon forgotten. On the French mansard roof 30 pillars carry each a 60-watt tungsten lamp enclosed in an opal glass ball globe. The white terra cotta facing at the third story level is illuminated in a similar way with 36 pillars and lamps. Four flaming arc-lamps enclosed in huge bronze lantern fixtures light the sidewalk from bracket suspensions, while the entrance on Hubbard Court is bordered by 84 25-watt tantalum lamps and lighted by twelve-lamp clusters.



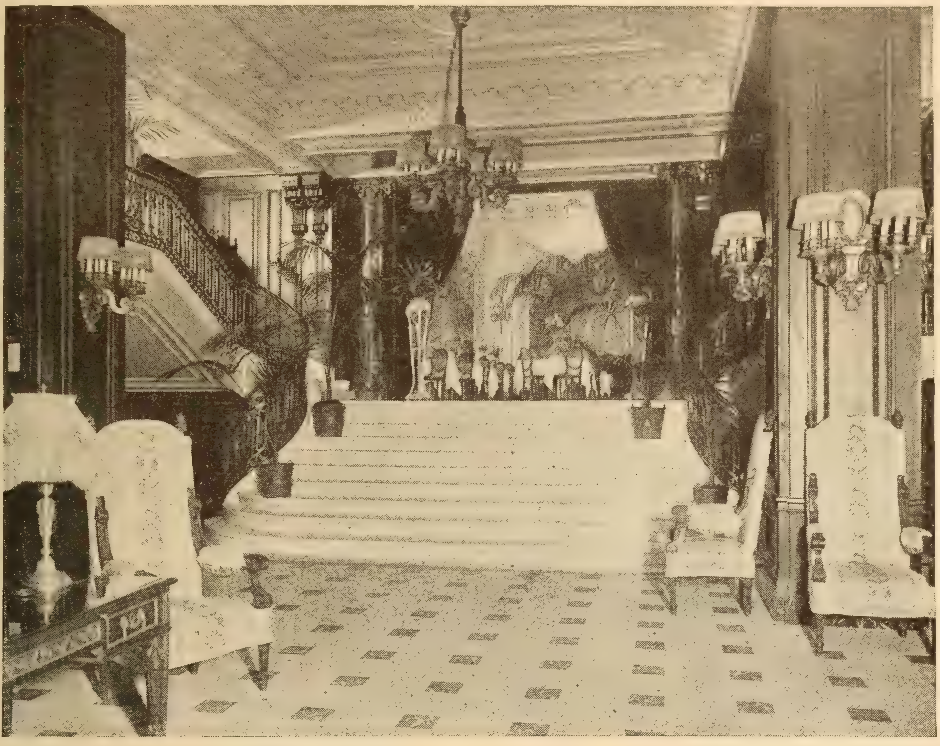
ELECTRIC GRILL ROOM IN THE HOTEL ST. FRANCIS

Carried out with greater care and in a more elaborate manner if possible is the arrangement of the interior illumination and electrical equipment. A total of 9,000 incandescent lamps of which 4,000 are tungstens, 2,000 are tantalum and 3,000 are carbon-filament, make up the lighting installation, the last named being used in side brackets about the rooms and the tantalums in portables. On entering the hotel, in anticipation of what is yet to come, the attendant at the door presses a push button and a small motor over the doorway revolves the door for your admission. At your right and up a few steps is the main dining room, impressive because of its size, the five massive electroliers carrying tiny lamps reflect by hundreds of crystal glass pendants upon them. On each table is an electric "candle" and examination will reveal a small storage battery for these "candles' mounted underneath. The art electroliers of the dining room and the ball room dazzle one so that a startling contrast is found on entering the Grecian marble cafe at the left of the lobby. Here not a light is visible, the indirect system of illumination being employed. This system is also used in the kitchen, buffet, and barber shop. This last has been pronounced the finest and handsomest shop in the world, the pale blue ceiling and the mirrored walls lending themselves well to indirect lighting. The chef as we passed through the kitchen remarked, "We have daylight here 24 hours in the day."

Private dining rooms large and small and gorgeously furnished afford means of entertaining friends and in whatever style one desires. Dumbwaiters operated by push buttons assist this service and by the aid of the pneumatic tube system eliminate to a great degree the hurry and scurry of bell boys and messengers.

Coming down to the facilities guests are afforded for the direct use of electricity in helping themselves we note that on entering any

THE BLACKSTONE HOTEL, CHICAGO



ENTRANCE TO THE MAIN DINING ROOM IN THE BLACKSTONE

room the lights are turned on by the operation of unlocking the door. These lights are controlled by a magnetically operated switch inside the room. On locking the door from the outside all lights in the room are turned out. Provisions are also made for connecting curling irons, and electric fans are furnished on request. In the baseboard in each room outlets are provided for reading lamps and fans. Of the 450 rooms there is not an inside guest room, all having outside exposures, and this is true also of the 350 bathrooms.

The exacting bachelor or business man will be pleased with the furnishings of his room and bath, mahogany predominating. On arising he may take his sponge or shower with water at any desired temperature, and then proceed to his morning shave aided by two adjustable electric lights, one on each side of the mirror. If he wishes a cigar

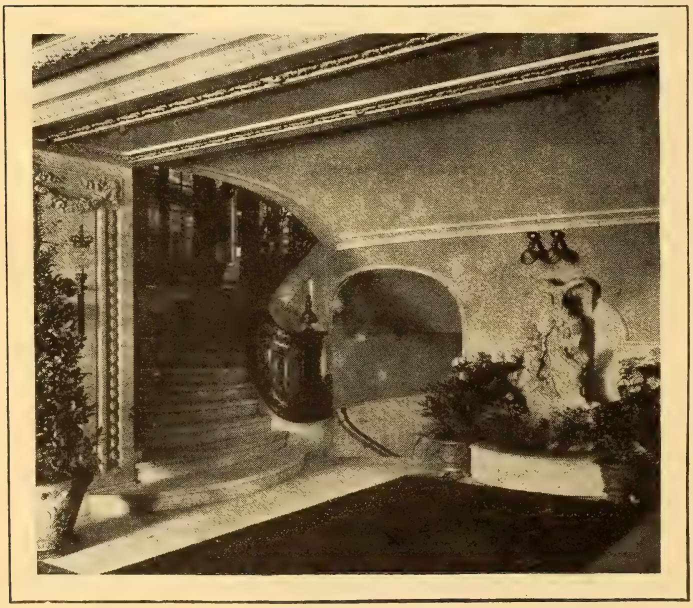
ART HALL, BLACKSTONE HOTEL

THE BEAUTIFUL BANQUET AND BALL ROOM OF THE BLACKSTONE

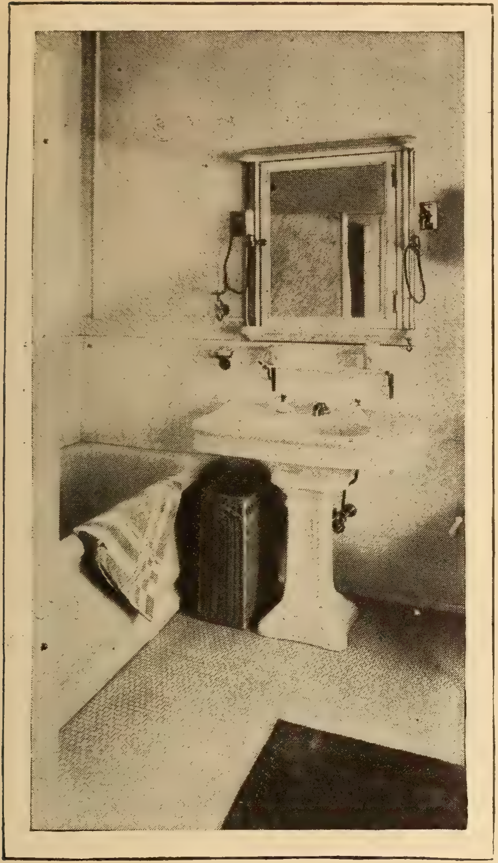
or paper he reaches for the telephone, calls a desk clerk, one being located on each floor, and as the order is given it is written by the clerk on a telautograph which rewrites the message under the eyes of a bell boy on the first floor, and almost before the order is finished his paper and cigars are on their way.

If the guest is a broker, a "ticker" wire may be drawn in through a special conduit run to each room for this purpose, and business conducted in private. A call for a carriage transmitted to the clerk's desk is immediately transferred to a switchboard with keys on it located in the lobby. By pushing these keys numbers are flashed through a glass sign on Hubbard court and by the time the guest has reached the lobby a carriage or automobile is in waiting.

The private telephone exchange should also be



A HALL AND STAIRWAY IN THE BLACKSTONE



ONE OF THE BATH ROOMS IN THE BLACKSTONE

mentioned. It consists of 450 instruments, four operators, 30 outgoing and 30 incoming lines. The telautograph system is made up of 28 transmitting and 32 recording instruments. Every order given is stamped with the time to a second by a time stamp system.

The fact that in all there are 72 motors ranging from one-fourth to 40 horse-power and totalling 500 horse-power, tells somewhat clearly how electric current is at work in the Blackstone, and probably one of the most peculiar uses for one of the small motors is that of turning a revolving "spit" for carrying a delicious steak before a grate of hot coals in the grill-room kitchen.

Besides doing the work in the laundry electricity propels the dish-hoist, buffs the silver, washes the dishes, sifts the flour, mixes the dough, peels the potatoes, operates the ice-cream freezers, and by motors connected to centrifugal pumps circulates the brine in the refrigerating system. All the public rooms are arranged so that artificially cooled air may be supplied to them and all rooms have an entire change of air at certain intervals by means of an extensive ventilating system.

The fire alarm system is of the best. Each floor and corridor is provided with boxes. By breaking a glass and turning in an alarm the location of the trouble is registered at once in the clerk's office and also in Chief Engineer Boomhower's office. At the same time electric lights outside at the landings of the fire escapes are automatically turned on. This feature for safety was given special attention, the lights being alternately taken from two circuits so that should one circuit fail every other light is left burning along the fire escapes from the top of the building to the sidewalk. Space forbids a detailed description of the plant behind this extensive electrical equipment, but it should be said that it is in keeping with the switchboard, which consists of fourteen panels of pink Tennessee marble

BLACKSTONE BARBER SHOP LIGHTED BY THE INDIRECT SYSTEM two inches thick, provided with the latest controlling apparatus. In all its completeness in other ways not touched upon The Blackstone has been proclaimed by managers and proprietors the finest hotel establishment in America.

The "Inside" of Moving Pictures

By ARNEY H. RITCHIE

THE mission of this article is twofold. Its prime motive is to explain to the patron of a moving picture show why the exhibition may suddenly stop in the middle of a picture and what has happened, and what is going on up in the operator's booth while the audience is waiting for things to continue. The other is to explain a few of the freakish things which are witnessed in some pictures.

Many there are, who have never been fortunate enough to examine closely a machine and its accessories, but who have experienced some of the exasperating difficulties of the operator, who labors with perspiring face while the anxious spectators crane their necks up at him, stamp their feet impatiently and wonder what is delaying the exhibition. It is to these that it is hoped this article will be of interest.

To describe in detail the operator's booth, the machine and the film used in producing the pictures, would require so much time and space that it wouldn't be interesting to the average reader. However, a brief description follows, which will be supplemented later on by describing several different parts of the machine whenever it becomes necessary to do so, that the reader may understand some of the operator's perplexities

The operator's booth is a small, hot, stuffy place. It is generally made of sheet iron, asbestos lined, and scarcely high enough to stand up in.

The moving picture machine gets its light from an electric arc, which is focused by means of lenses, on a thin celluloid film or ribbon about 1½ inches wide, on which the pictures are developed. This film, which is usually 1,000 feet long, contains about fourteen pictures per running foot, and when run through the moving picture machine, is pulled down, a picture at a time, from a reel on which it is wound, so that the pictures pass upside down through the focus of the arc light.

Each picture as it passes down into the focus of the light, stops there for an instant and is reproduced right side up on the screen, or curtain, as it is often called. Then the light is cut off for a similar interval by means of a shutter, during which interval the picture just shown is pulled down and the next picture is pulled into the focus. The next or second picture is in turn reproduced as the shutter again opens and allows the light to shine upon it for an instant, and so on. If it were not for the shutter, the spectator would see, instead of moving pictures, a continuous blur in which nothing could be distinguished.

The mechanical movement which pulls down the film and at the same time manipulates the shutter, is operated by turning a crank by hand. To turn the crank is one of the duties of the operator—the machine is not driven by an electric motor, as many imagine, except in a very few theatres.

These films which are so necessary to the operation of the moving picture theatre, are rented from film exchanges. The exchanges purchase their films from the film manufacturers, who make a business of taking moving pictures, and hire high-priced actors, acrobats and comedians for that purpose.

The film which the operator runs through the moving picture machine is not the original picture that was taken with the moving picture camera by the manufacturer. The cost of taking the first or original film is so great, ranging from $1,000.00 to $10,000.00, that the film rental would be too high for the picture shows to pay. Furthermore, by the time one-tenth of the shows in the country had used it, it would be worn out. The original or first film is

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THOMAS A. EDISON AND ONE OF HIS GREATEST INVENTIONS, THE CINEMATOGRAPH OR MOVING PICTURE MACHINE

therefore used as a negative from which any number of similar films may be printed. In this way the price of a film is very much reduced, averaging $125.00 per film. The film exchanges buy the films from the maker at this price, and rent them to the theatre owners at prices ranging from $25.00 to $150.00 per week for fourteen reels a week (a change a day). A new film is more valuable than an old one, not only because it is clearer, but because it is "first run" film, and has not been shown by other competitors.

The average five-cent theatre shows two reels or approximately 2,000 feet of pictures during one complete show. The morning after the show, the two reels are returned to the Film Service from which that particular theatre rents its films, and two more are secured for the next evening. If the theatre is located in a country town, it will be necessary to return the films to the exchange by the first express. It would not do to get a week's supply of films at one time in order to save express, as the value of the rental of each film for the six days it would be standing idle, is worth many times more than the express charges saved by having one express fee to pay instead of seven.

Now that we have some idea of the machine and film, let us investigate some of the difficulties the operator has to contend with. It often happens that the electric arc, which is generally the source of light in a picture machine, gets out of adjustment. If it does, he has to keep turning the crank while he adjusts it. Frequently one of the carbons in the arc light slides past the other, cutting off the light and making the picture dim. The operator then has to remedy this, and do it, if possible, without stopping the machine and disappointing the audience. This necessitates his turning a crank while he fixes the obstinate carbon.

To do this, he first opens the door of the lamp-house which contains the electric arc light. This door is kept shut by a strong spring, and if no catch is provided to hold it open, he has to hook it to his trousers leg with a piece of wire, or put a large weight on it to keep it open. Then he reaches for his rubber-insulated pliers, which are always lying near the machine. Meanwhile, he is turning the crank with his right hand, and as his left will not quite reach the pliers the way he is sitting, it is necessary for him to shift hands, and turn the crank with the left while he gets the pliers with his right. After he has secured them, he can't put them in his other hand, because it is now engaged in turning the crank of the machine. If he lets go for the tiniest instant, the machine will stop or slow down so much that the highly inflammable celluloid film, instead of moving through the hot rays from the arc light which are focused upon it, will come to a standstill and take fire, causing panic and disaster. There is no alternative but to put the pliers between his teeth, in order to change them from one hand to the other. After having accomplished this, he resumes turning the crank with his right hand and proceeds to pull the carbon back into place with the pliers which he has finally succeeded in placing in his left. All this is the work ot a moment and must be done while he keeps the crank turning at a uniform speed, and reaches into a lamp-house that is hotter than the hottest bake oven, taking, at the same time, a chance of burning his wrist on the hot door, or of getting a good "jar" from the electric lamp which he is fixing. Many are the burns an operator receives in this way, just to keep the thoughtless audience interested in the picture that is before them, whereas if he could stop the machine for a few seconds, he could adjust his troubles in one-third the time, and do it with no discomfort to himself. But this is only one of his troubles.

Perhaps the most frequent cause of trouble is the unsplicing or breaking of a film. It is very seldom that a complete film of 1,000 feet or even much less, is composed of one unbroken film, even though it contains but one subject. When pictures of parades, and scenic pictures are taken, several thousand feet of film are used. It is then developed and the clearest and most interesting and prominent parts are selected, spliced together in the order in which they belong and made into a 1,000-foot reel. This accounts for some of the occasional changes of location or viewpoint in such pictures, but it doesn't account for the jumps in some other pictures, as we shall see later.

But to return to the operator, however, he may be running a picture, let us say of the Knights Templar parade. Everything is going along nicely and he is watching the screen through his "peephole" to see that the picture is clear. Suddenly he sees a white flash on the screen. He knows something has happened to the film, and instantly releases his foot from a cut-off, which he holds down all the time the machine is in operation. By so doing, he cuts off the hot rays of light from the film so it won't catch fire. An examination of the film shows that it has parted at one of the places where it was spliced. The audience is waiting, meanwhile, and he must hurry. He snatches up a pair of scissors (which he has on a shelf in front of him), seizes the upper part of the broken film and cuts off the old edge where it was spliced, gauging it so that he cuts off about a quarter of an inch more than one of the complete pictures. This extra quarter inch of film he moistens with the tongue and scrapes clean with the scissors blade, thus removing the portion of the picture which was on it.

Next the lower end of the film is found and the old splice cut out in such a manner that the film is cut exactly on the line of a complete picture. He then applies a little transparent, quick drying film paste which he has in front of him in a handy place, and blows on it to make it congeal more quickly, then applies a trifle more paste. Now grasping the lower end of the film which he has been holding between his knees, he takes the upper part bearing the paste, and holds both up to the light to be sure he is splicing the negative or picture bearing side of the upper end of the film to the corresponding side of the lower, then puts them together, and holds them firmly for about ten seconds until the cement has set.

This has to be done in such a manner that the one-quarter inch of film on the upper end which was scraped to make it transparent, will lap over the lower end and allow the light to shine through the picture over which it is spliced. It requires but a second to "thread" the film in the machine and he is off again. The relating of this in words takes a long time, but if the operator is an experienced one, he can mend a broken film in the manner just described, in three minutes or even less, if everything goes well. But everything doesn't always go well.

On some machines the film is rewound on a "take-up" reel which is similar to the upper or "feeding" reel and is located under the base of the machine. This reel takes up the film as fast as it runs through the machine. When this is used, and the film breaks, it is easy to find both ends.

Other machines are fitted with a sheet iron box about three feet long, a foot and a half wide and two feet high, closed at the top except for a trap door about four inches square, through which the film enters the box. When the film breaks, the lower end falls into the box and if there is much film in the box, a great deal of time is consumed in trying to find that end.

One would think that cutting a piece out of a film when making a splice, would make a jump in the picture. So it would if very much film were cut out. As many as three complete pictures may be removed from the film without making any perceptible difference in the picture on the screen, although a good operator removes as little film as possible when he makes a splice.

It often happens that an inexperienced operator while adjusting the carbons in his lamp, will forget to keep turning the crank, and slow down so much that the film is scorched for a number of feet. Before he can make the next run, he will have to cut out the scorched portion and make a patch, otherwise the next time he runs the film, the audience will see a dark, blurry picture as the scorched place passes through the machine. This scorched place has to be removed, and so much generally has to be taken out that it causes a "jump" in the picture at that juncture.

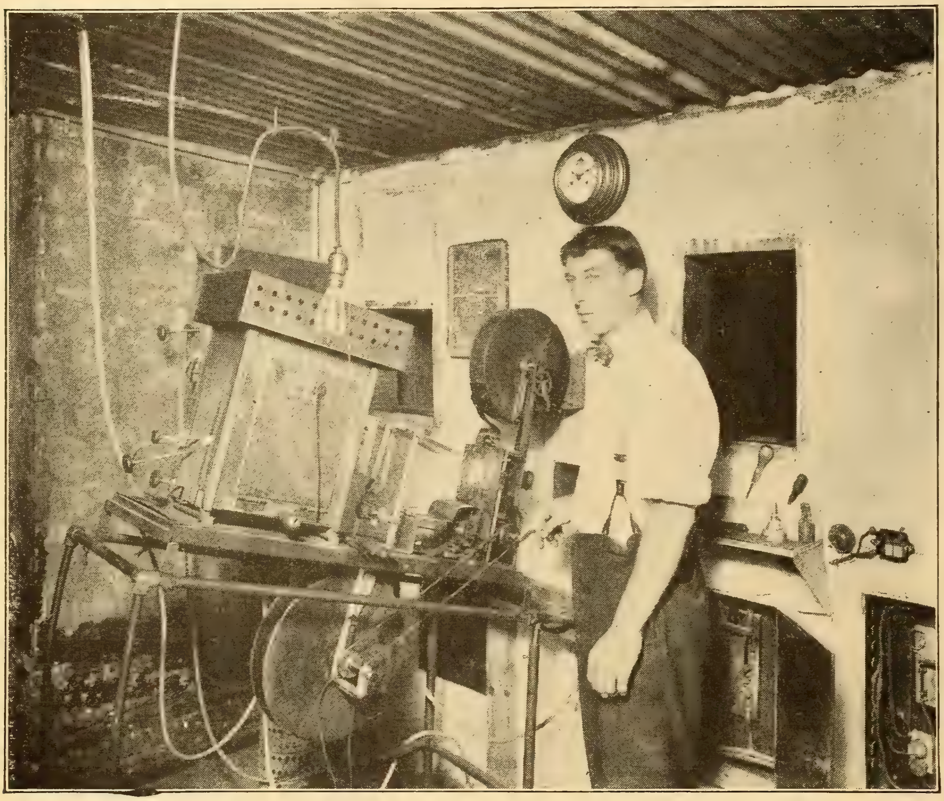
After a film is run through the machine, it has to be rewound before it can be shown again. During this process, it often becomes unspliced, and very frequently torn, especially if it is wound from one of the metal boxes previously mentioned. When the film is rewound from the box, into which it falls loosely, it snarls very easily, and comes up in big bunches clogging the hole. Before the operator can check the re-winder, which he turns at a fair speed, the tender celluloid ribbon is pulled so tight that it breaks. That means more patching.

Another bugbear of the operator comes in the form of worn sprocket holes. In order that the film may be pulled down through the rays of light, little oval shaped sprocket holes are punched in both edges of the film, into which little teeth on either side of a small revolving cylinder fit, and pull down the film. As the film gets old, these sprocket holes are worn into each other by the constant friction of the sprocket teeth on the cylinder, until finally there are no holes at all in some places, but instead, a long slit on either side of the film. When this slit in the film reaches the sprockets and is about to be passed through the machine, the film comes to a standstill, as there are no holes for the sprocket teeth to fit into. If the operator isn't minding his business, the film will scorch, and take fire unless he immediately cuts off the light from the now motionless film.

Using an electric light as most machines do, results in another source of trouble for the man behind the picture. The heat from the arc light is so intense that it melts off the wires which are connected to the lamp arms which hold the carbons, even though the wires are as large in diameter as a lead pencil, and asbestos covered. When a wire burns off, the show has simply got to stop until the lamp can be removed from the lamp house, and the wire again fastened. The lamp, which of course is almost red hot, is hard to handle, and for that reason it takes some time to fasten the wire to it, especially if it is found that the thumb screw to which the wire is fastened, has melted and refuses to turn. Under such circumstances the operator has to bend the stiff, heavy wire around the metal arm which holds the carbon the best way he can and trust to luck that he will get a good contact and plenty of light till the show is over.

Among the things which annoy the visitor at a picture show, is the lack of a title to a film. The picture starts off without a title or name, so that one really doesn't get any idea of what is going on until the picture is over. This is due to the fact that the many operators who have run the same film, have been careless in rewinding, and have torn off little pieces from the title (which is usually two or three feet long), until there is little or no title left. As there are fourteen pictures per running foot on the film, so there are fourteen titles per foot. If there was but one title, it would flash on the screen but once, and as it would remain there but a small fraction of a second, the spectators wouldn't have time to read it.

Rainy films spoil many pictures. The appearance of rain in a picture is a sure sign that the picture is an old one. The effect of rain seen in the picture is the result of very fine scratches on the film which are highly magnified when they are projected on the screen. The film becomes scratched as it travels down through the machine and passes over dusty or gritty places. It is further scratched in rewinding by the operator, who holds the film between his fingers to guide it. If his fingers are sweaty or oily, they will pick up dirt and carbon ash (the latter from the burning carbons). This dirt will scratch the film, and give a rainy appearance to the picture.



VIEW INSIDE OF A TYPICAL MOVING PICTURE OPERATING ROOM

Another thing which puzzles many who are not familiar with moving picture apparatus, is why a picture runs along nicely, then suddenly jumps out of place so that the upper half of the subjects in the pictures are seen, while there is a black line above their heads, above which their feet are moving around. This is because some careless or inexperienced operator has improperly mended a film, the result being that the pictures are thrown out of alignment so that each picture does not come squarely over the aperture hole in the machine which is exactly the size of one picture, and through which the light must shine. Instead, the last half of one picture covers part of the aperture hole, while the first half of the next picture covers the remainder of the hole. Thus portions of two consecutive pictures are shown at the same time.

As soon as the operator sees that the picture on the screen is "out of frame," as it is then said to be, he proceeds to "frame up" by turning a little lever which will so move the aperture hole up and down that it will exactly cover a complete picture. Then the picture looks natural as before.

A picture which is nice and bright is sometimes seen to go dim for an instant; sometimes for a number of seconds. This is the result of the operator "freezing" the carbons in the arc lamp. The arc lamp of a moving picture machine is not automatically fed as are those which are seen on the streets and boulevards, but has to be fed by the operator who slowly turns a little knob which brings the carbons together as they burn apart. He has to learn to gauge just how much to turn the knob, otherwise he will turn it so much that the carbons touch each other, and extinguish the arc. They are then said to be "frozen." By turning the knob back a trifle, the carbons separate, the electric current jumps from one carbon to the other, and the arc is again formed.

The show to which the patron's nickel admits him does not consist entirely of annoying incidents. Very amusing, and seemingly impossible things are seen on the moving-picture screen. Many of them, which baffle the wisest to explain, are very simple when understood.

The one most met with is the disappearing of imps and devils who turn handsprings and disappear in a cloud of smoke. These are acrobats dressed as imps. They wait on some fairy queen, then bow obeisance to her and turn a handspring or back somersault; all this while the man with the moving-picture camera takes the picture. Just as the imp turns the handspring, the operator of the camera, who we will call the "camera man," stops his machine and allows the imp to walk out of range of the camera. Then through a steam pipe which is located right where the imp turned the somersault, a spurt of steam is ejected. The camera man instantly resumes turning the crank of his machine, takes the picture of the steam, and continues with the rest of the picture from which the imp is excluded. In place of steam, electrically ignited smoke pots are sometimes used, giving practically the same result.

Then there are pictures in which furniture, including bedding and dishes, move from one house to another, money counts itself, shoes give themselves a shine, and so on. These are called stop-work pictures, and are very tedious to make. Take, for example, the picture of a shoe being automatically shined. A brush is set on a shoe, and the man who takes the picture turns the crank just enough to expose one picture. Then while the camera is closed, his assistant moves the shoe brush a little further over on the shoe. As soon as the assistant has receded from the range of the camera, the crank is again turned just enough to make one more exposure. By moving the brush a trifle at a time from the shoe to the blacking, and alternately taking a single picture of the brush and shoe in their different positions, the complete picture is obtained. When this is reproduced in rapid succession on the screen, it looks as though the brush were actually shining the shoe without any aid. All pictures of this nature are taken in a similar way, including pictures where the subjects get to waltzing around fast enough to make one dizzy.

Visions are made by exposing the film twice before developing it. For example, a picture is taken of Johnny going to bed. The man operating the camera machine so calculates the picture that he gets a sufficiently long picture of Johnny in a sleeping posture, to last during the vision which he intends to make. Then he rewinds the film back to the place where he would imagine Johnny fell asleep. After he has ascertained this, he takes a picture of a girl dressed as an angel, on the same film, posing her in such a manner that when the film is developed, she will appear to be standing in the air above Johnny's bed.

In another class of pictures where a very serious accident occurs to one or more of the subjects, dummies are used, as in pictures where someone falls from a window, or from a scaffold. Let us take the case of a carpenter going to work on a high building. We see him ascend a ladder, reach the scaffolding and begin his work. He walks out on a narrow place, loses his balance and falls, and is picked up dead—that is, most of the audience think so. As a matter of fact, the picture is really taken of the man until he slips. Just as he loses his foothold, the camera is stopped. The carpenter either catches on something to keep from falling, or jumps only a few feet to a platform below which is out of the camera's range. All of this is not shown in the picture because the camera is not being operated.

At this juncture, a dummy which is an exact duplicate of the workman, is put in the same position as that in which the man was last seen at the time he lost his foothold. The dummy is then dropped and the camera again operated, showing the man falling until he strikes the ground, when the camera is again stopped, and the dummy carried away. Then the man who is supposed to have fallen, lies down in exactly the same place where the dummy struck, and assumes a lifeless attitude. He is picked up and carried home to his family, who grieve terribly over his sham death.

Everyone who has witnessed the picture of an automobile or carriage, has seen the wheels revolve naturally as the machine starts slowly. But as soon as the machine gets under way, the wheels go backward. This is rather difficult to explain in words, but perhaps the majority of the readers will catch the idea from the following explanation.

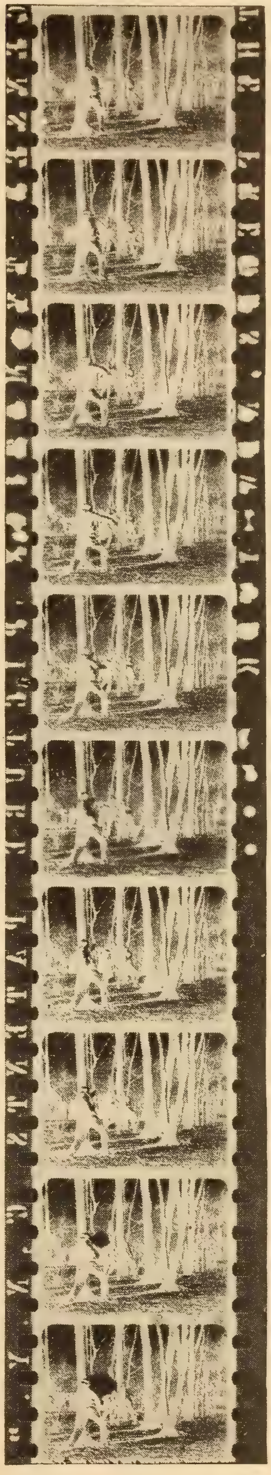
In the first place, let us suppose there was only one spoke in the wheel, and that it travelled clockwise and made two revolutions per second, while the shutter of the camera machine opened and closed five times per second, taking five separate and distinct pictures of the spoke in motion. If the spoke were vertical when the first picture were taken, the second picture would show the spoke one-fourth the way round, the third would show it one-half way round, the fourth would show it three-fourths the way round, etc. These pictures when reproduced successively, would show the spoke as turning around in the same direction as it did when its picture was taken.

Now suppose that the spoke goes faster and faster until the number of revolutions it makes is greater than the number of pictures the machine takes per second; say it makes six revolutions per second, while the camera takes but five pictures in the same time. Assuming that the first picture showed the spoke vertical as in the former case, the second picture would show it at three-fourths revolution, or one-fourth revolution back of the starting point, and as there have been no intermediate pictures showing how the spoke got around so fast, it presents to the eye the appearance of going backwards as the next picture will show it just three-fourths of a revolution from the last place, which would be just half way round, or one-half revolution back of the starting point. Thus instead of appearing to travel clockwise, it appears to travel the opposite direction, or counterclockwise.

One very pleasing sight witnessed in some picture theatres is that of the dissolving song slides. By the use of the "dissolving stereopticon" one picture melts away into another by which it is gradually replaced. The "dissolving stereopticon" consists of two separate stereopticons, one above the other, each of which has its own individual arc light, and set of lenses. They are so arranged that when one is in focus, that is, capable of producing a clear picture on the screen, the other is out of focus. As soon as the operator has shown the full reel of moving pictures, he turns out the light on the machine, and either he or an assistant lights both the arc lamps of the double stereopticons, and inserts the title slide of the song into the stereopticon which is in focus. He then inserts the first of the series of colored song slides into the other stereopticon, and proceeds to bring it into focus by sliding it forward. As he does so, the colored picture becomes faintly visible, while the title begins to grow dim—dimmer—then vanishes completely and is swallowed up by the clear picture of the colored slide. When the title slide is drawn out of focus, it is taken out and the next colored slide inserted, then brought into focus, and so on till all the slides have been shown. It might be well to add that the dissolving stereopticon is too expensive for the ordinary theatre and that most theatres use a single stereopticon which comes with the machine, and is operated much after the fashion of the old magic lanterns which are so familiar to all.

From some of the foregoing statements, the reader is apt to get the impression that the moving picture show is a dangerous place to be in, owing to the inflammability of the films used in connection with the exhibition. This was so in the early history of moving pictures, especially two or three years ago at the time they became so popular. Now, however, with the use of special fire protection devices which are used in connection with the machines, it is only occasionally that a theatre burns, and then the fires are the result of pure carelessness or ignorance.

The reel of film which is being run, fits into a circular metal, close jointed, fireproof box, just large enough to accommodate it. The film is fed out to the machine through two rollers. The "take up" reel, if one is used, is also fitted in the same way. Thus if the film catches fire from any cause whatever, it will burn but about two feet of film, there being about that much film between the upper or feeding reel, and the lower or take up reel. Repeated experiment has proved that the film will not burn past the rollers because the fire is smothered at that point. Where the heavy iron box, before mentioned, is used in place of a take-up reel, in case of fire, the trap door is shut by a spring. As the door flies shut it tears the film in two. This prevents the film in the box from taking fire.



SECTION OF A MOVING PICTURE FILM

But of still more value is the late discovery of a transparent, non-combustible composition to take the place of the inflammable and dangerous celluloid used in the manufacture of films. Films of this material have been in use for more than a year, and are gradually supplanting the celluloid ones and reducing liability of fire from that cause. Thus on the whole, a properly conducted moving picture show is safe.

Before concluding this article, a word about trade marks will undoubtedly prove interesting, as they are often the topic of discussion among moving picture theatre goers. The one most indelibly impressed on the memory of all, is that of a red rooster. This is the trademark of Pathé Freres (Pathé Brothers), France. Another often seen is Selig's diamond. The Selig Polyscope Company makes a specialty of Western and Indian pictures, and this trade mark is generally seen in a conspicuous place on a hunter's cabin, a prominent tree or a large boulder. Other trade marks are, the Essenay Company's Indian head, the Edison Company's E inscribed in a circle, and the Biograph Company's monogram AB, while the Vitagraph Company's eagle and Lubin & Company's shield are others often seen.

In conclusion it is hoped that the next time the reader visits a moving picture theatre, he will feel that he is in close touch with what is going on, both in the operator's booth and on the screen. It is also hoped that this article has sufficiently initiated him into the mysteries of the realm of moving pictures, to make the show far more interesting than ever before.

The Lure of the Tattoo

Curious Fad Which Has Spread From Seamen to Landsmen, and Once Begun Knows No Bounds

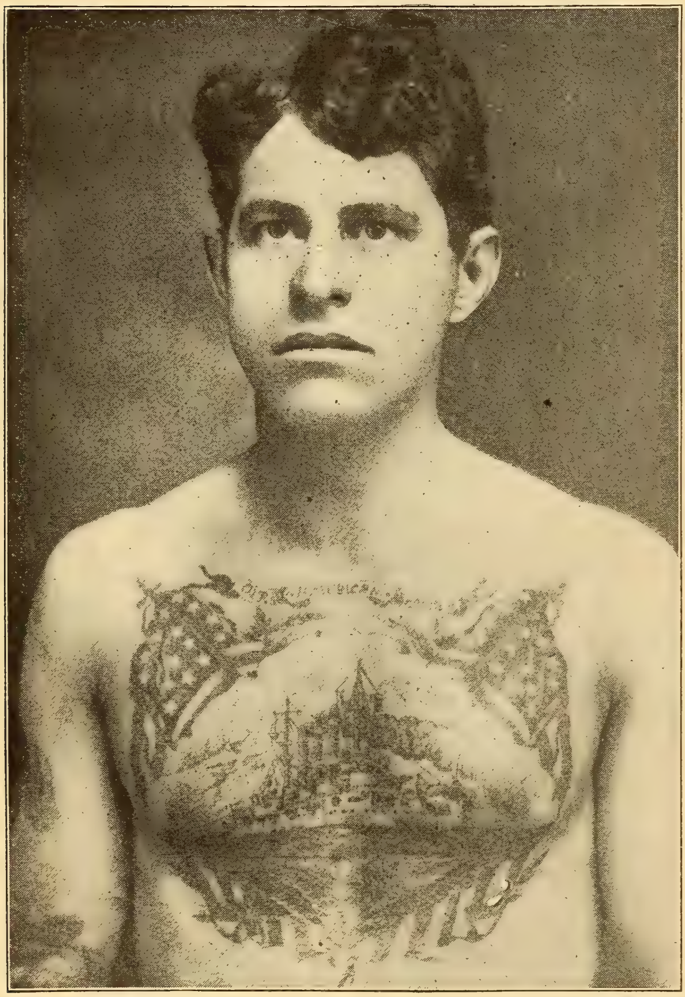
By FELIX J. KOCH

Those of us who have looked with silent envy at the decorated arm or breast of a sailor on the liner's deck, or who have wondered what strange fancy drove the tattooed man of the circus tent to decorate his hide after such wise, had best take the advice of one who knows, and never yield to the lure of the first tattoo. If they do so yield, as sure as time rolls on, they will not pass a tattoer's stand without dropping in and securing further decoration.

Tattooing is by no means a passing art Where the shooting galleries and the five cent theatres and the carousals thrive, there look for the tattooer. He is chatting with one of the tattoo fiends, for such they grow to be, just as do cocaine and morphine and tobacco fiends, and as they talk you note a part of this one's adornment. See there on the wrist there has been done a band, as an imitation of a bracelet. Above this there is a rose, with a butterfly nestling upon it. The rose branch ends in a leaf with a caterpillar, and to this there come, as a crown, three other leaves and a bud. Higher up still, remark that dragon-head, which runs into the bottom. And above it, still, is a globe, and, finally, a Japanese design.

Now this is but a sample of what you will find about town, and it is by no means an exceptional specimen.

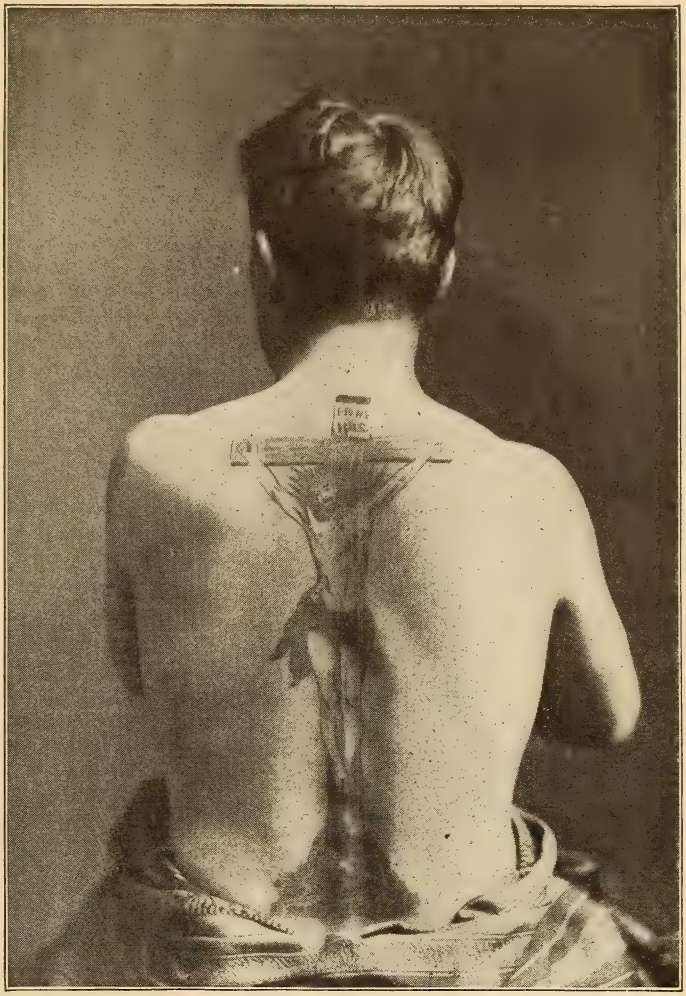
When a novitiate comes, with the usual bare arm, he is asked to select a design from a book of these, or from patterns on the wall. Of these designs each tattooer has his own, or again several will exchange, passing patterns from hand to hand. Each operator makes designs as well and has these put into books for sale. The de-



ELECTRICALLY TATTOOED DESIGN, FOURTEEN INCHES SQUARE, WHICH RESEMBLES AN OIL PAINTING IN COLOR AND DETAIL. REQUIRED THREE SITTINGS OF TWO HOURS EACH signs appear in colors. There are seventeen colors or shades that can be made. The only basic color which can't be used is white, while green, black, red, brown and blue predominate. Nothing is made in white, it seems, as there is a top layer of skin whch grows over the tattoo, and this eventually gives a dirty color to the effect. There is no white that proves practicable in the work against this growth. Barber, the noted Ohio tattooist, tells us that he has worked on white several times, but not yet has produced results.

In tattooing, the price varies with the amount of work done, rather than with the size of the design. Jobs will range from 50 cents up. Nothing under half a dollar is accepted, and such a job will occupy ten or twelve minutes.

Meanwhile, on the wall, you are searching the designs. Some are indeed unique. Yonder is the photograph of August Pefferman, a drummer on the road. who has a crucifix upon his back. Another photo is of a boilermaker, who has an American battleship on the breast, with American flags about, the flags being at the top; the new Maine in the center; the American eagle beneath, making the whole almost like an oil painting. That was a 35-dollar job and occupied three sittings of two hours and a half each to cover it, and it was all done by electricity.



DESIGN IN SEVEN COLORS TATTOOED BY THE ELECTRICAL PROCESS IN ONE SITTING OF 3½ HOURS. LENGTH OF DESIGN 19 INCHES

In contrast to the new electrical method, the old method was to do the tattooing by a hand operated needle. Seven very fine needles were set, as a brush, in an ivory holder. The design was drawn on the skin with a toothpick by the tramp artist and then cut in in this wise. The design was first made in outline. It was then gone over a second time, to fill up the spaces, and then the design was carefully shaded in. The most popular color formerly was some shade of red.

The old method was very painful; the present one is not. In fact, a man may sit two and a half hours a day, being tattooed, and work at his bench next morning. There is just a burning sensation at the start, much like that which a hot needle will produce. In about three minutes' time the skin is dead, as it were (unless the subject be a very nervous one), and one then pays no attention to the feeling.

Stencils are now made of any design. They are cut into celluloid, so as to leave a rough design. Once you have picked out the design desired, the operator brings out this celluloid pattern. A powder is rubbed on this, the celluloid is pressed on the arm and the outline of the pattern is left on the skin. At once the operator proceeds to follow this. He always works from the bottom up, so that the ink will not run. These inks are of a special sort and guaranteed pure colors. In fact, they are hardly used for any coloring but tattooing.

The outline is first put on in black. This is all gone over until it is as near perfect as possible. Then the operator takes a shading machine for the blending of the black. Then he puts in all the black shades, and leaves all the spots reserved for other colors, as blanks.

After the black, he puts in green or brown, filling in these spaces. Then comes the red, then the yellow. Lastly the blue, which is one of the hardest colors to put in, due to the difference in the way the pigment is ground. If a color be dainty, one can't tell how much of it has been worked in and so results are uncertain. Red and yellow and black, on the other hand, work in easily.

Little blood is drawn as the work goes on, though this depends on the person, just as in a surgical operation. Different persons bleed in varying amounts. Bleeding does not affect the work, the arm being washed off clean again and again, so that all blood and all loose color are removed.

Next an antiseptic solution is wiped over the whole, and it burns for five or ten minutes. The design sweats, and so it is covered with a cloth for an hour or so.

By and by one finds a gummy substance formed on the top of the skin, and in a short time the whole has healed.

One day after it is done, the tattooed section of the arm appears to be covered with water blisters in places. There is but little swelling. The third day these blisters dry up, and the skin is tighter and firmer. On the fourth and fifth day the skin grows white, and then one finds the scale hardening, cracking and drying up. By the eighth day the top-skin scales off, leaving the bright tattoo design. This is the design which is on to stay.

As the years go by, gradually a very thin layer of skin grows over this, but if this top layer is scalded the tattooing comes out bright once more. Tattooing can be done right over scars and vaccination marks so as to cover these up.

Curious indeed are some of the patterns put on the skin by Barber. Yonder is a sketch of "Aurora, Queen of the Dawn," in her chariot, with her angels about. He put that on the back of a man in Columbus, in two sittings, one of five hours and one of four, these sittings a week apart. Another notable pattern is of the Liberty Queen, seated on an eagle, with ribbons all about her. Still another is of a cowboy, on a bucking broncho. One design reveals the "Birth of Bacchus," another "Siegfried and the Dragon."

In the mid-west patriotic designs are most popular, these often being added after the initial or the name.

The basis of electrical tattooing is vibration. The electric current does not, as many suppose, have any effect upon the skin, the pigment being simply forced in by electrically operated needles. The vibration is secured by the same principle as that of an electric bell, the needle bar being attached to an armature bar which crosses the magnet. This bar causes the needles to vibrate up and down over a distance of from $\frac{1}{8}$ to $\frac{1}{4}$ of an inch. These vibrations are estimated to be at the rate of 1,000 a minute. As to the apparatus, the needle bar goes down into a tube, shaped much like a lead pencil, the point being very fine, just allowing a single needle to protrude $\frac{1}{8}$ inch. This makes the outlining and is attached to the machine for outlining purpose only. For shading and coloring work a pencil-shaped tube, flattened at the end so as to allow eight to ten needles to come out is employed. This pencil-like holder is attached to the electric coils, which in their turn are set in a frame.

Even as we are chatting with the tattooist the young fellow who dropped in a moment before has made his choice, a girl in a red design; 75 cents it will be. He takes his seat at the table by the electric light and says nothing. The artist, the while, picks out the needed stencil. The stencil is rubbed in a black powder in order that the relief design may print. Then the arm is set on a buck of black oil cloth. It is washed with a sponge and then shaved with a razor, to take off any hair, which will grow out again over tattooed spots. Meanwhile, he is taking a solution and making the skin perfectly free from any grease and the like which the soap does not wash out. Then the design is laid on. There is a Japanese bowl of metal containing antiseptic, and in this lies one end of the machine. It is applied and you see the boy wince.

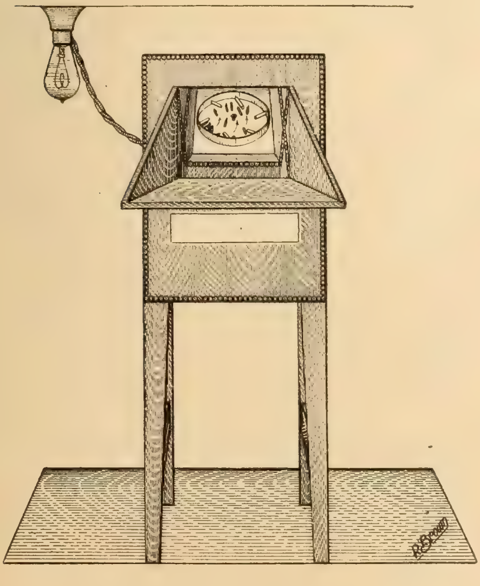
The artist dips the needle into a little glass vial of black ink and traces the outline. He is holding the arm in one hand, with the other he plies this needle. You see the design grow in the black ink, till gradually you have the entire outline. Children peer in at the door, and you hear the reports in the shooting gallery. The outline done and the ink washed off with a sponge, you see the artist going about putting in the little details. There is a bit of blood which he brushes away with his finger.

"This ain't the first time," the victim says. "The more you get on you, the more you want."

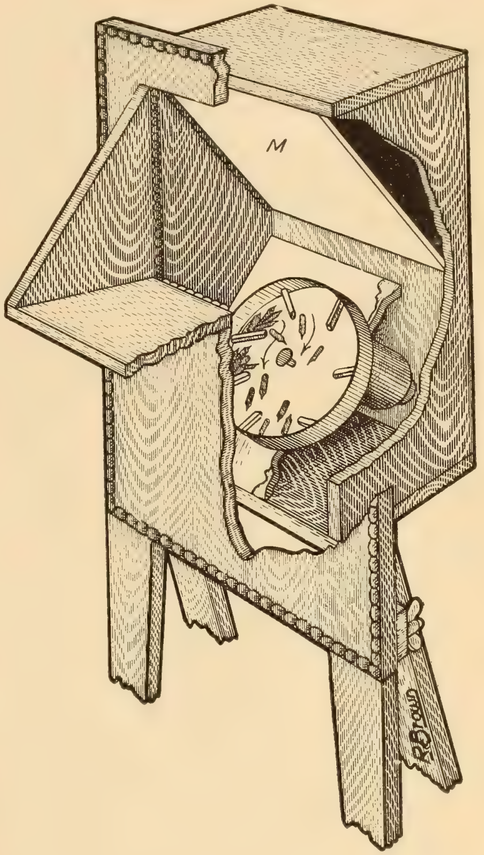
By and by it is done, the mark is on, and the victim departs. Next week he'll be back for another design, and then, ere long, for another.

Seeing is Believing

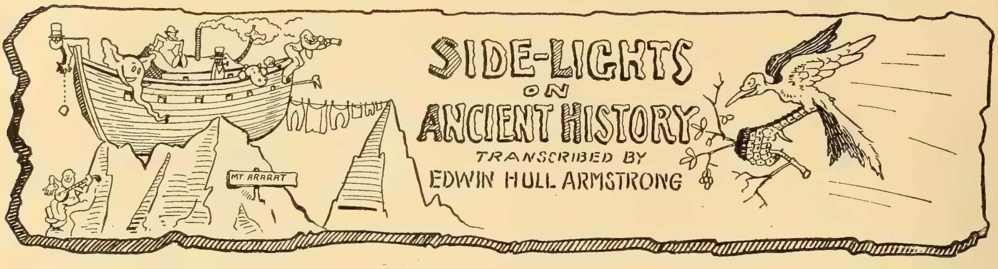
Even if "seeing is believing," "things are not always what they seem." Jones, who is an electrician and a positive sort of fellow, didn't believe the latter proverb until recently. With a friend he chanced to stand in front of a show window gazing at a revolving flat-bottomed glass dish as shown in the first picture. In the dish were steel pens which on reaching the lower side as the dish turned, immediately slid over the glass to the upper edge of the dish. Jones, seeing the lamp and flexible cord, immediately explained to his friend that a strong magnet placed beneath the upper edge of the dish attracted the pens. The next day Jones took another look and standing on his tip toes saw on looking down into the cabinet a revolving dish just like the one above but with the pens dropping down by gravity, while closer inspection revealed a perfect mirror (M), the arrangement being as shown in the second picture. Jones now says, "Look twice before you speak." The device is run by a small electro-magnetic engine, the lamp being in series with it.



HOW IT APPEARED



HOW IT REALLY WAS



SIDE-LIGHTS ON ANCIENT HISTORY

TRANSCRIBED BY
EDWIN HULL ARMSTRONG

Recently some copies of some old publications have fallen into our hands (it matters not how, except that we came by them honestly). Thinking that some of these ancient writings may be of interest to the readers of Popular Electricity we take the liberty of reproducing some clippings from them. In producing this diversion for the magazine's readers, we have been careful to select those items that bear particularly on electricity and its manifestation and uses.

◇

For a long time Noah felt that something was bound to happen. He thought first of earthquakes, and then of famine and finally became convinced that there was to be a flood. He told his fears to but few of his friends. Those to whom he confided coughed, shook their heads and winked at one another. Then they met outside and said:

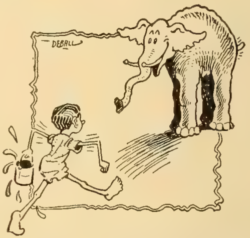
"It's too bad. He's growing old."

The novelty of the view, however, was such that becoming known, the big dailies sent reporters to interview Noah, and the Sunday editions were full of his predictions and plans. For about fifty years the public had heard occasionally of Noah and his projected Ark and the voyage he expected to make. During all this time he refused, though pressed to do so by all the sensational sheets, to indicate a time when the flood was to come. As Noah's grandfather Methuselah was still alive, and past his nine hundredth year, and as there were no indications of a flood, Noah's predictions became to be regarded as visionary, and emanating from a member of a family that was inclined to be freaky.

In building the Ark, it was Noah's first idea to save all the people in town from a watery grave. Finding, as time passed, that his ideas were held lightly, he proclaimed that only his own family, his sons with their wives and children, should go aboard the Ark. This is the truth about the matter and just how it happened.—*Deluge News.*

Some idea of the inner life of those who made the voyage on that celebrated vessel, the Ark, may be gleaned from the following clipping from the *Deluge News:*

They sat huddled together on the upper deck, a cheerless group of men and women. The moist skies continued to weep. They had been weeping in precisely the same fashion for the last three weeks. For the fifty-seventh time the eyes of those present looked at the gloomy skies, wondering if ever it would quit raining. Suddenly an "Oh-eee-oou" sounded from below and a small boy came bounding up the stairs and fell on the deck, writhing in agony.



A Bucket of Rain Water for the Elephant

"What's the'matter?" came in a chorus from the women.

At that moment Ham came out of the office. "I sent that boy down with a bucket of rainwater for the elephant," he said. "He is usually gone two or three hours, so I insulated the monkey cage the other day, and this morning I turned the current onto the bars."

As the boy gradually recovered and limped away, Noah remarked to the women:

"Hammy will kill that boy with these new fangled litnin' fixen's of his," and shaking his head thoughtfully he made his way to the greenhouse to pull a few stalks of pie plant for dinner.

◇

Ham's youngest child cried all night. Occasionally it would get to feeling kind of comfortable. Then a fresh spasm of pain would grasp it and it would yell louder than ever. The mother was asleep, but the other women were sympathetic and helpful, all but Shem's wife. She was mad. After breakfast she made her way to Noah's office.

"I want another room," she demanded sharply. The old man pushed back his glasses and looked at her in surprise.

"W'y what's the matter, Agnes," he asked with a trace of concern in his tone, "Oh, Ham is always so busy with his electrical devices he has no time to look after his family. Now his wife is so careless," she said, wearily, "she lets those children of hers eat any old thing, and at night she tells them they oughtn't to have eaten such stuff. Then she goes to sleep and the rest of us are kept awake. I wish there were no children aboard," she said with a shrug of her aristocratic shoulders.

"But you know," said Noah, elevating his eyebrows, "this voyage is to preserve worthy remnants of the race, a kind of an anti-race-suicide project."

With that she bridled up and said:

"Look here, I'm a republican and have the utmost respect for Mr. Roosvent's views, but when it comes to being kept awake half the night by a couple of brass-lunged youngsters, I say no squalling brats for me."

Noah gave her another room.—*Ark Record.*

◆

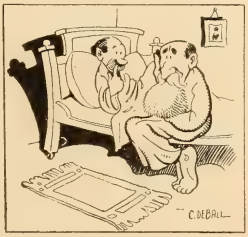
Noah sat in the dining room looking over the Sunday school lesson, by the light of a cotton rag floating in a saucer of lard. As he grew sleepy the head of the old patriarch drooped lower. Finally he blew out the light and shuffled off to bed. As the light went out a small boy called up the stairs jubilantly:

"He's gone!"

Ham touched a button and the effect was marvelous. The old water-logged craft was transformed to a thing of beauty, and as the electric piano pealed forth the gay crowd went skimming over the floor inspired by that famous modern melody, "Waltz me around again, Willie." Every night after Noah retired, there was a continual round of gayety at the Ark.—*Ark Record.*

◆

It had been an active day for Ham. While Noah had been busy in the horticultural department, Ham had insulated all the animal cages, completing the circuit by placing strips of tin on the floors. He had the wires connected to the one in his bedroom. So Ham was tired. He lay in his bed listening to the rain patter on the shingles above his head. Occasionally he heard a commotion among the animals, far below in the hold. Old Madge the hippopotamus would give a grunt, which would be taken up by Bess, the elephant, and the lions would join in, followed by the lesser fry. To Ham, young and healthy as he was, the noise was more pleasing than otherwise, and he was just falling into a doze when a light tapping at the door aroused him.



"Hammy, my boy, I can't sleep"

"Come in," he said cheerily, and Noah entered.

"Hammy, my boy, I can't sleep," said the old man, seating himself on the bed and rubbing his jaw with his bony hand. "The animals haven't got used to their quarters yet and that old snag of a tooth is bothering me again. I should have had that tooth out 220 years ago.

"Don't let little things like those bother you," said Ham, touching a button, whereupon the cries of the animals instantly ceased. Applying the battery to Noah's tooth, the pain quickly subsided.

"That 'lectricity is wonderful stuff," said Noah as he made his way to his bedroom below.

—*Ark Record.*

◆

The very night Noah put an advertisement into the daily papers for carpenters, Ham took up the study of electricity.—*Deluge News.*

◆

Those who think Noah had an easy time of it, and had nothing to contend with, are away off their base. From the very beginning of the work, a gang of loafers swarmed about the site of the vessel, making mean remarks. As Noah was inclined to be mild, and was much absorbed in his work, they got to betting that there would be no flood. Methuselah, who was always the center of a crowd, to whom he would relate past experiences, treated these remarks in silence. But when the loafers grew bolder, and offered to bet, three to one, that it would be as dry as August all the time, he grew interested. Once when Noah was at camp meeting, he took Ham to one side and told him it was a shame for money to go begging at those odds. Especially as it was a sure thing. Ham took all the bets that were offered, Methuselah furnishing the money. When the time came, and it was seen that the flood was no spring freshet, there was a rush to see Ham and square up. The crowd thought that by paying promptly an invitation aboard might be secured. Ham took all the money offered and then told the fellows that he had nothing to do with the transportation department, but that he knew where they could get some good life preservers. "You'll have to hurry," he said, "there is to be a combination and the price will go up next week."

Told Him it was a Shame

This is how our well-known citizen got his start.—*Mt. Ararat Daily News.*

Where Electricity Stands in the Practice of Medicine

By NOBLE M. EBERHART, A. M., M. S., M. D.

CHAPTER XI.—ELECTRICAL FAKERS; MEDICAL ETHICS; ETHICAL MANUFACTURERS, ETC.

As I have remarked in previous chapters one of the greatest drawbacks to the advancement of medical electricity has been the disrepute cast upon it through its extensive use by charlatans and fakers.

The mysteriousness of electricity and the surprising phenomena produced by it have lent themselves to this purpose, coupled with the general ignorance of the subject on the part of the people at large and their ready acceptance of any claim made for it, however extravagant it might be.

Ignorance of the properties and uses of electricity, especially forms other than galvanism or faradism, was not limited to the laity, but extended also to the majority of the medical profession.

This was due primarily to the neglect of the subject in the medical colleges where little or no time was devoted to teaching electricity. It was augmented by the natural resentment the legitimate practitioner felt on account of the extravagant claims of those physicians outside of the fold, who advertised it as a "cure-all."

The ethical doctors knew it could not do what these men claimed for it and were prejudiced to the degree that few cared even to ascertain just how far this force was capable of conquering disease.

Had it not been for the discovery of the X-ray I think this condition would still prevail, but so great was the interest aroused in this branch that in the fifteen years that have elapsed since that time, more physicians have come through it to know and to use electricity in their practice than in a whole century previous.

When carefully and intelligently studied in its various phases it is found to be the same as other methods or remedies; successful in certain cases; useful in others, and worthless in many.

That this force is closely akin to the life principle itself, is an opinion shared by many of its advocates and thus we hear the expression "Electricity is Life." Certainly one of its most prominent therapeutical properties is its power to stimulate nutrition and other vital processes.

On account of its successful use in some conditions not otherwise considered curable, it is not surprising that even a doctor possessed of good judgment and common sense should be carried away by the resultant enthusiasm to the point where his claims are almost as extravagant as those of the charlatan.

Electricity has no firmer friend nor stauncher adherent than I am, but I welcome this opportunity to counsel the medical readers of Popular Electricity to remember that whatever the future may hold, at present it still has its limitations and must not be exploited as a cure for all ills.

Again there are many conditions curable by electricity that are equally amenable to other measures. The conscientious physician should be careful about advising electrical treatment for some trouble that might be more easily cured by other means, or with less delay and less expense to the patient.

While I have the opportunity of addressing so large an audience outside of the medical profession as I am able to reach through the medium of this magazine, I am going to devote a little space to the consideration of a point or two coming under the heading of "medical ethics," a subject entirely misunderstood outside of the profession and upon many phases of which even insiders are occasionally inclined to cavil.

The average business man looks upon the physician who has a successful remedy or treatment as a fool for not exploiting it by means of the newspapers and thus reaping the financial reward which the former knows comes from judicious advertising. Furthermore the average man does not know that newspaper advertising is forbidden to the ethical physician and that those thus exploiting their services are outside of the pale of the medical societies and classed by the remainder of the medical world as "unethical;" which carries with it an opprobrium similar to that of a worker who does not belong to the union composed of his fellows.

That a doctor is foolish from a financial standpoint to be bound by a code of ethics essentially unchanged for decades, undoubtedly is true, but there is more than dollars and cents in the practice of medicine, however necessary the latter may be. To place the saving of life and the curing of disease solely upon a money basis would be an unwise procedure, to say the least, and if the physician were permitted to advertise, how could general fraud be prevented?

Material products, such as drygoods, groceries, hardware, etc., can be judged of by the purchaser, but in the case of professional services they must be taken on the claims of the vendor, if advertised.

What an opportunity for the unscrupulous! I have known even some conscientious physicians who really believe they had "sure cures" for certain diseases (cancer or consumption, for instance), and always found some apparently good reason for their failures, which were never the result of the inadequacy of their treatment! What then of those who intended to deceive?

Without further discussing this phase of existing medical ethics I make the point which the lay reader should bear in mind, that the physician who advertises is without standing in the medical profession.

There is another point which is lost sight of frequently which is brought out by asking one question. "Who pays for this advertising?" It must eventually come out of the patient's pocket.

Furthermore, the doctor who advertises has not the incentive for the highest grade of work, because his practice does not depend upon his praises being sounded by satisfied patients, but upon his shrewdness as an advertiser.

At the same time, in all fairness, it should be stated that occasionally capable physicians have been lured from the ethical field by the financial attractiveness of the advertising game, or have left because they rebelled against the restrictions of the code of ethics; and there are advertising physicians that are undoubtedly as well qualified and trying as hard to cure their patients as their ethical brethren, but they are woefully in the minority.

The ethics of the profession binds not only the physician but also manufacturers making apparatus or drugs used by them. These manufacturers are supposed to limit their advertisements strictly to the medical journals and not go into general publications. They must advertise only to physicians. Technical journals might be considered an exception; for obvious reasons.

Thus the ethical manufacturer is bound as closely as the ethical physician, and is not supposed to sell his goods to the layman unless authorized to do so by a physician.

One of the most widely advertised methods of faking the public by means of extravagant claims where only a slight amount of electricity existed is in the sale of electric belts.

All of the possible therapeutic properties of electricity and then some additional ones have been ascribed to these belts, which are in reality capable of developing only a slight amount of galvanic current, far less than the average home battery.

It is strange how many people have the idea that rings and other devices are capable of generating sufficient electricity or magnetism to ward off rheumatism.

I have been assured positively that the wearing of a small metal ring has cured rheumatism, and not so very long ago a physician in this city came to me to consult me concerning his rheumatism, and I found when he took off his clothing that he was wearing two or three turns of copper wire around his waist, under the impression that he was producing an electric current that would benefit his case.

Frequently we see magnetic insoles advertised for rheumatism and other troubles. Another machine is on the market that is attached to the ankle or wrist at night, while the apparatus is placed in a vessel of water alongside the bed and is supposed to entirely rejuvenate the individual over night. None of these things possess enough electricity or magnetism to be of any real curative value.

The reason that the manufacturers obtain honest testimonials for these fakes is that many people suffer from imaginary ailments, and any application often convinces them they have been cured by it; furthermore, the large majority of acute ailments are self-limited and tend toward a restoration to health whether or not any form of treatment is employed.

(The End.)

Talks With the Judge

HE SEEKS INFORMATION ON OZONE

The judge yawned rather heavily and seemed at a loss to collect his thoughts sufficiently to start one of his long-winded stories. He had just come out of the pool room at the club, where he had failed to clean up at a game of Kelley. The room had been close and he was depressed.

"HE WANTED TO SELL ME AN OZONE MACHINE"

"I guess what I need is ozone," he said. "And, by the way, I have wanted to ask you about it. The other day an agent was up at my house and wanted to sell me an electrical ozone machine. He told me if I were to put one in my bedroom I would have 'mountain air' all night. I would never have hay fever; would sleep like a log, and feel like a lion all the time. It sounded all right, but you know me. I put a great many things over, myself, by conversation and I wouldn't buy any ozone machine until I at least knew what ozone was. What is it? How do they make it?"

"Well, Judge," I remarked, " 'Mountain air', as they call it and hot air are two different things. The particular kind you are not familiar with—the 'mountain air' or ozone—is what chemists have sometimes called an allotropic form of oxygen. Ordinary oxygen in its free state has its molecules made up of two atoms of oxygen which cling together forming a fairly 'stable' gas. By certain processes, however, the atoms of oxygen may be made to combine in threes to form a molecule and the molecule so formed is a molecule of ozone. Ozone is a very unstable gas and will not last long without combining with some other substance. That third atom in the molecule doesn't seem to be wanted there and it has a little feeler out ready to grab onto some other atom. This is what gives ozone its germicidal properties. Bacteria are made up of carbon principally. Turn some ozone loose in a flock of germs and the molecules of ozone readily break down, one of the oxygen atoms combining with a carbon atom in a bacterium and oxidizing the carbon as the chemists say—literally burning it up. In this way germ life is destroyed by ozone.

"Now ozone can be made in various ways, but the best way is by an electrical discharge. That is the reason the air is so peculiarly fresh and invigorating after a thunder storm—the lightning flashes have created ozone in the atmosphere. The artificial way of making ozone by electricity is to make miniature electrical discharges by a small machine. There are various types of these machines now on the market, but they all follow the principle of causing an electrical discharge between two electrodes or sets of electrodes. A high voltage is first created sufficient to make the current jump from one electrode to the other in the form of a silent or 'brush' discharge. The air is drawn through this discharge area and then blown out into the room, and it is decidedly invigorating."

MAN-LIFTING KITES

At the Boston-Harvard aero meet a number of man-lifting kites of the Perkins type were utilized. Some of these kites were as high as fifteen and eighteen feet, the latter leviathans of the air being capable of lifting a man to a height of more than 125 feet. These man-lifting kites have been of great value in making scientific tests of the upper air currents, so that the aviators may know just how to handle their machines, the aeroplane operator being able to note with assurance the direction and force of the upper atmospheric current.

A wireless telegraph equipment has been devised for war purposes, to be carried by the kites, so that a scout may not only be able to observe the forces of the enemy for many miles about but may also be in constant communication with the military headquarters.

Modernizing the City of Damascus

As a rule, the Orientals have showed themselves unfavorable to the progress of our scientific discoveries. This is especially the case in Turkey—or at least it was so under the old regime. The telephone and such things were not to be heard of, and the introduction of electric appliances was often resisted by force.

It is, therefore, an irony of fate that in one of the oldest cities of the Orient, Damascus, electricity has triumphed most decidedly, and is used not only for street lighting, but for street railways, the current being taken from an electric central station plant lying a few miles above the city on the Barada River.

When the opening of the electric street railway was celebrated, the governor-general of the province and the commanding general of the Fifth Army Corps were present, together with the heads of the civil and military bodies, the principal men of the city and the consuls of the sovereign powers, as guests of honor. A special representative was also present from the Turkish imperial government. The electrical company in Damascus is called the Société Ottomane des Tramways et d'Eclairage électriques des Damas," and its lines extend from Salhyeh to Meidan, uniting these two suburbs, which are at a distance of about five miles apart.

In the meantime Damascus has introduced electric light also. The city government itself has 1,000 electric lamps on the street, paying therefor about $12,500 a year. But the municipal government is not the only customer for electric light; many private individuals—not only Europeans but also numerous Orientals—have had the lights installed. Today, even the great Mosque is lighted electrically.

The stock company that serves Damascus with electric light and railway is of Belgian origin. Some of the machinery was brought from Germany, England, and France; but all the electric cars, motors and dynamos are of Belgian manufacture.

"Strong" on Electrics

In the little city of Rockford, Illinois, with 50,000 inhabitants, there are 145 electric vehicles in daily use. That means 3.5 electrics to every 100 people, and some of these cars have been in service for over ten years. Probably there is no other city in the country so "strong" on electrics.

Time Signals Aid Mariners

The thought of checking one's watch at sea by signals from the wireless station on the Eiffel Tower even though several thousand miles from the latter, is interesting to the layman, but also has a decidedly practical value to the navigator. The reason for this is that in determining the position of the vessel by means of a sextant, the observer must be sure of the exact time at which he measures the elevation of the sun (or of certain stars) above the horizon, otherwise his deductions will be out of the way. Thus in latitude 55 an error of one minute in the chronometer will make a difference of a quarter of a degree or about ten miles in the calculated longitude. The error increases steadily as we approach the equator and may make an appreciable difference in the ship's course or even be a source of danger when nearing islands or reefs. For this reason the time signals from the Eiffel Tower are not only sent out exactly at midnight (for a period of one-tenth of a second) but are repeated at two-minute intervals for the benefit of vessels which may not have caught the midnight signal. To distinguish the later signals the one sent out at two minutes past twelve is preceded by the Morse signs — · · while the one sent out at 12:04 is preceded by — · · · ·

American Engineering for Russia

"Only in the United States can I see these things. In Europe we have short electric lines, and while they are well equipped and have very good machinery, they are so very small that they do not meet Russian conditions, and so I came to the only country in which these are approximated."

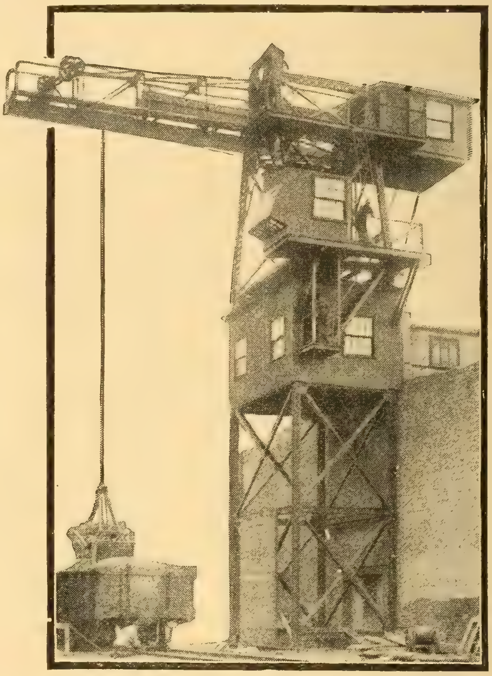
This compliment to American electrical engineering was paid by M. de Chatelain, professor in the Polytechnical Institute of St. Petersburg, who has been sent to this country by the Russian government to gather information as to the best methods of producing electricity by water power.

Steam-producing coal in St. Petersburg is about twice as expensive as here; this is an argument for electricity derived from water power. The problem which M. de Chatelain will try to solve after his visit in this country is that of electrifying the seven double-track roads within a radius of 60 miles of St. Petersburg.

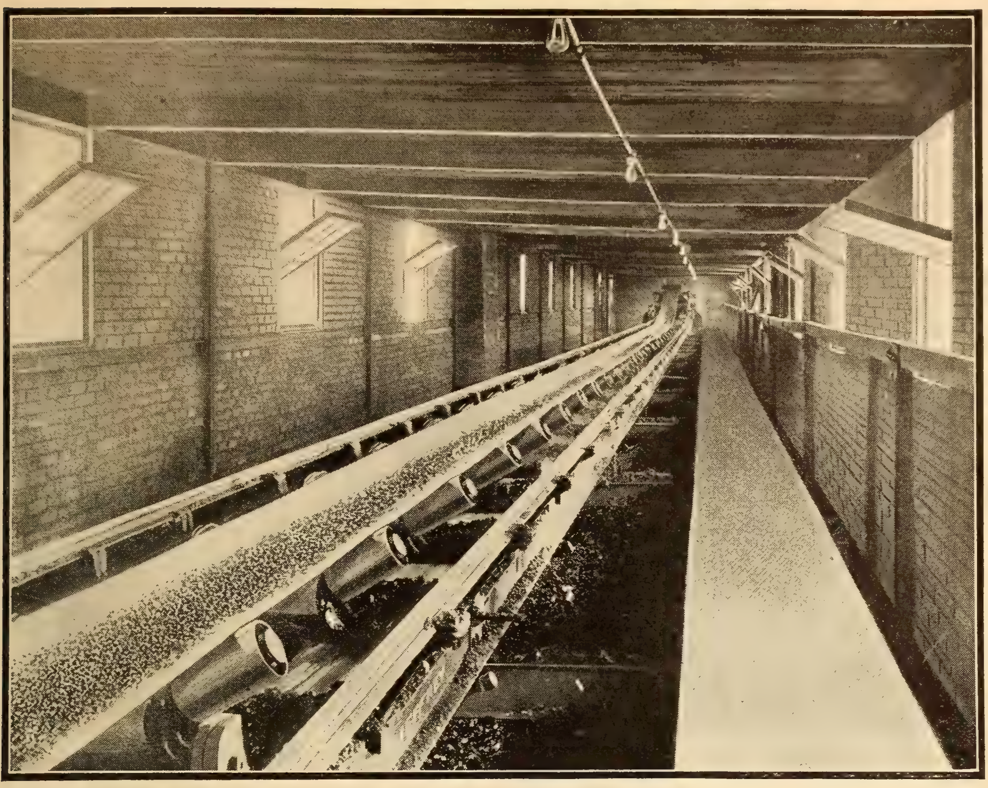
Feeding the Furnaces

In the August issue of Popular Electricity was shown a modern boiler room where not a pound of coal is ever handled by the old laborious methods, but entirely by mechanical means. A somewhat different way of doing the work is illustrated by the accompanying pictures taken at the plant of the Peoria (Ill.) Gas and Electric Company. As in the previous instance, from the time the coal arrives at the plant in cars until it is fed into the grates hardly a turn of hand labor is required.

The cars arrive at the plant and are run up beside the cantilever tower. The coal is what is known as "mine run" and is of all sizes from fine dust, almost, up to pieces of large size. When the car is in place a little motor driven truck runs out on the cantilever until it is directly over the car and then drops a "clam shell" grab bucket attached to a long steel cable. The bucket automatically grabs a mouthful of the coal and is drawn up, again by motors, almost to the cantilever crane. The cantilever then swings around and the coal is dropped into a receiving hopper and from there



CANTILEVER TOWER AND GRAB BUCKET FOR UNLOADING COAL



SIX-PLY CANVAS CONVEYOR BELT WHICH TRAVELS OVER THE COAL BUNKERS

passes by gravity to a crusher. Before it drops into the hopper, however, it passes through a reciprocating spout-like arrangement with perforated bottom, through which all the small coal and dust falls and is by-passed around the hopper.

The large pieces pass from the hopper into a crusher and are broken up into small, uniformly sized pieces which are delivered onto a great six-ply canvas belt which is constantly traveling along over the coal bunkers.

By an ingenious arrangement of "trippers" the coal may be delivered from the belt to any one of the bunkers under its 225 feet of travel. These bunkers are above the boilers of the plant, and coal from them is easily led down through spouts to the automatic stokers which feed the furnaces.

It is stated that not more than 1,000 pounds of coal will remain in the car, the grab buckets handling nearly every particle of the fuel, a single laborer only being necessary to clean up each car.

An extremely simple method of handling the ashes coming from the ten fires has been adopted, the waste material being dropped into deep steel barrows which are taken to the pit and are loaded into the cars by the grab bucket.

X-Ray Moving Pictures

Just as it took the camera to show us the true motions of a trotting horse, so it may be that X-ray pictures showing the motions of our internal organs will throw new light on the same and perhaps correct some of our present assumptions regarding them. With that in view Drs. Rieder and Rosenthal of Munich have been testing an outfit which takes a dozen radiographs in quick succession, each exposure requiring only a fraction of a second. Reports from Munich state that they have already succeeded in thus recording the motions of the human stomach. As the rays only show the presence of metallic, or at least very dense bodies, it is customary in experiments of this kind to give the subject a "bismuth meal," as described in Dr. Eberhart's article in the October issue.

Old Time Electric Machines

The only means of producing an electrical charge known at the beginning of the Seventeenth Century was the simple method of rubbing one substance against another: a piece of sulphur with the hand; a cake of resin with fur. The first arrangement that could really be called an electrical machine was built by von Guericke as shown in Fig. 1. He filled a large glass bulb with molten sulphur and after this had cooled broke off the glass. An iron rod was then heated and passed through the ball of sulphur for use as an axle about which it could be rotated when suspended as shown. On pressing the hand or cloth against it while being rotated, it became charged and could then be removed as shown at the left.

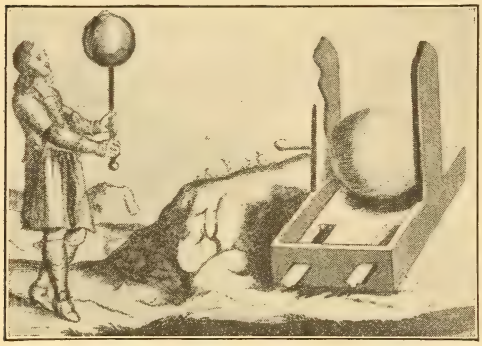


FIG. 1. VON GUERICKE'S MACHINE

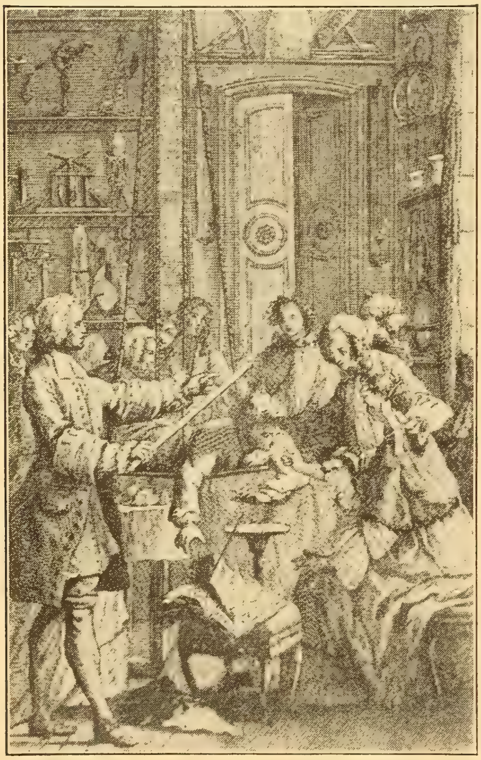


FIG. 2. THE PHENOMENON OF THE ELECTRIFIED BOY

Many machines were made of rotating spheres or cylinders of sulphur or glass; but these were eventually displaced by glass disks. The friction of the glass plate against a leather pad underneath it produced the charge, which was collected by a ring. The latter was made of wood covered with a strip of metal holding metallic points which faced the glass and conducted the charge to the insulated sphere. The leather pad at the bottom was coated with zinc amalgam which was connected to earth by the chain. An improved type of this machine was used by Nollet when he demonstrated the phenomenon of the electrified boy as illustrated in Fig. 2. The boy was suspended by silken

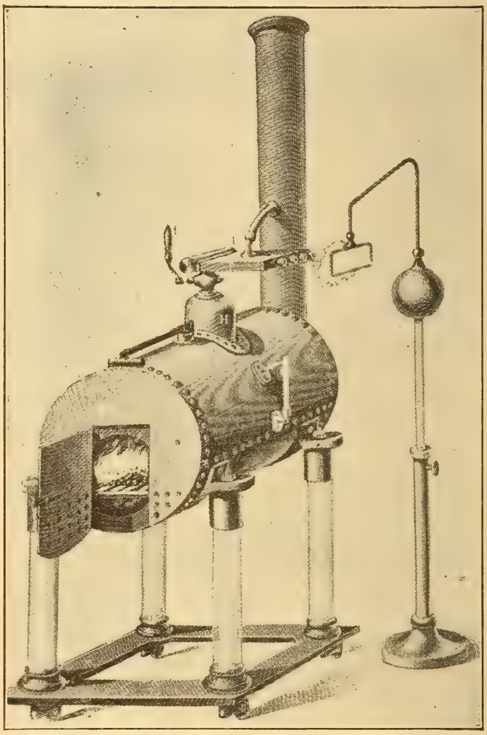


FIG. 3. THE ARMSTRONG MACHINE

cords and charged with electricity. Sparks could then be drawn from him by extending a finger Likewise it was found that pith balls could be attracted and repelled in a merry dance.

Probably the most curious of all electrical machines was that of Armstrong, built about the middle of the last century and illustrated in Fig. 3.

Faraday in his experiments had found that electrification was produced on the passage of air or steam through tubes of various kinds, provided liquid particles were present; but there was no electrification on the passage of dry air or steam through the pipes. In an Armstrong machine this can be accomplished by condensing some of the steam in the pipes before it issues. The steam in the cylinder (bc) passes out through four pipes which pass through the water cooler (F). The tubes are made of brass with an interference at the outer end so that the condensed steam is not all blown out. The tips of the brass pipes are made of hardwood.

The steam upon issuing from the brass pipes strikes the wire gauze and imparts to it a positive charge, while the insulated boiler becomes charged negatively. The electrification produced in this way increases as the pressure of the steam increases; under a steam pressure of six atmospheres considerable quantities can be generated.

A Far Sighted Scientist

Those who imagine college professors to be impractical theorists who would be unlikely to see phenomena in their practical bearings, may do well to scan a little book issued just 20 years ago by the London Society for Promoting Christian Knowledge, entitled "Spinning Tops." It was written by Professor John Perry as a popular presentation of a lecture which this well known English electrician had delivered before the British Association for the Advancement of Science while in session at Leeds. Note what Prof. Perry said, back in September of 1890:

"If more attention were paid to the intelligent examination of the behavior of tops, there would be greater advances in mechanical engineering and in a great many industries."

From that point then he proceeds to show the principle by which ordinary spinning tops balance themselves and from that the principle of the gyroscope which tends continually to stay in one plane when once started rotating at high speed. Had his hint been heeded, would we have needed to wait nearly a score of years for Brennan (or his German rival Scherl) to develop gyroscopic balancing devices for vehicles and steamers?

Again he says—20 years ago, mind you: "We now know from the work of Prof. Hertz in the last two years that Maxwell's theory is correct and that light is an electromagnetic disturbance. And what is more, we know that this now recognized kind of radiation may be reflected and refracted and yet will pass through brick and stone walls and foggy atmospheres where light cannot pass; that possibly all military and marine and lighthouse signalling may be conducted in the future through the agency of this new and wonderful kind of radiation. Why, at this present moment, for all I know, two citizens of Leeds may be signaling to each other in this way through half a mile of houses, including this hall in which we are present."

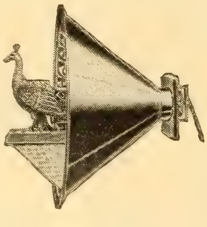
That was seven years before Marconi organized his wireless telegraph company. Since then the sending of aerograms has made rapid progress, yet the utilizing of the spinning tops whose principles were so clearly set forth by Prof. Perry in 1890, is still to come.

Another year may bring the top principle into use and perhaps still another will show the logic of two questions which the same British scientist propounded 20 years ago, pretending then to quote them from school examination papers of the year 2090: "Can you account for the crass ignorance of our forefathers in not being able to see from England what their friends were doing in Australia? Messages are being received every minute from our friends on the planet Mars and are now being answered: how do you account for our ancestors being utterly ignorant that these messages were occasionally sent to them?"

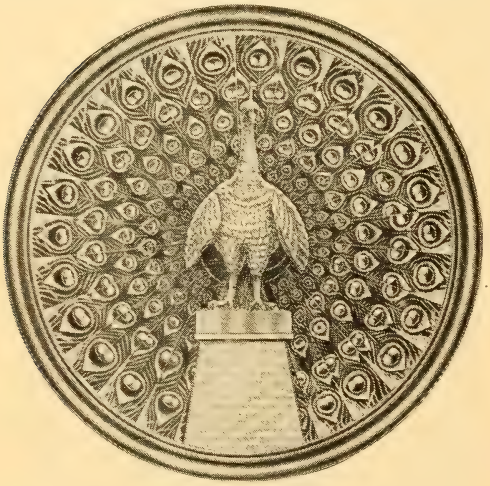
With a score of years elapsed since these questions were asked, ought we not to be half ashamed at our slowness in living up to Prof. Perry's veiled predictions, even though we may be proud that America is contributing its share towards utilizing such of these possibilities as have so far been turned into realities for the good of the human race.

An Electric Peacock

Only the color blind could fail to be fascinated by the gorgeous play of colors in the tail of the peacock when he spreads it into a disk and waves it in the sun. This same effect in a show window may seem even more fascinating and certainly cannot fail to attract and hold the attention of those passing the window. Particularly is this true when the wheel of feathers is brightly lighted in the evening and the play of colors continually shifts from feather to feather, as it does in the so-called color-mirroring peacock made for show-window purposes by Ludwig Bracker of Hanan in Germany.



This consists of a conical reflector say about two feet in diameter and one foot deep, studded on its mirrored surface with about 25 imitation peacock feathers slightly raised on the surface of the glass. In front of the reflector, as if walking out of it, is the body of a peacock nicely modeled in zinc and colored true to nature but cut off at the back so as to hide an incandescent lamp and a color changing screen. The latter is slowly rotated by an electric motor belted to a small pulley just outside the tip of the reflector, and its slow motion produces the shifting play of colors on the feathers which is so true to nature and so fascinating to the eye. Of course the current required for both lamp and motor would be very small, hence the cost of operating would be only nominal although so unusual a window novelty might well repay a heavy running expense.



ELECTRIC PEACOCK

A Suspended Figure

The hum of busy machinery was growing steadily louder as we approached the rows of factory buildings that stretched along the tracks and occasionally our words were drowned out by a loud rumbling and jangling as of mingled bells and bricks tumbled on each other. Coming nearer we found the cause of this noise in an electric traveling crane that was unloading some cars of pig iron with an electro-magnet, letting each ton of bars drop suddenly when the current was shut off. The November mist made a haze through which the cars and crane stood out as vague silhouettes against the strip of sky between two of the buildings and as the magnet rose again its load of bars clinging to each other looked almost like the figure of a woman.

"Shades of Bulfinch Emmons!" exclaimed my companion. "How he would leap for joy if he could see that!"

"Emmons? Who is he?"

"Who was he, rather," answered my literary friend. "Come up to my room after supper and I will show you. Why, he would want to rise from his grave to see this."

Vivid indeed were my dreams that night, after an evening spent in poring over the book by Emmons which my friend delighted in showing me—one of those works which thrilled the speculatively minded of fifty years ago. It was a volume entitled "Popular Superstitions," full of tales of ghosts, haunted houses and so-called animal magnetism, all told in language that was far more vivid than scientific. One of these accounts was of a German peasant girl, Frederica Hauffe, who was described as so magnetic that the nails in the wall affected her nerves, and whose face could be distorted by passing a magnet near it. Among the tests said to have been made on her by her physician is one in which he "placed his fingers against hers and by extending his hand upwards, he raised her clear from the ground; thus she was suspended by her fingertips as a magnet suspends a piece of iron; and afterwards his wife did quite the same thing."

When I came to this passage I understood why my friend had been thrilled at the foggy spectacle of a woman raised high in air, a sight that would have started a whole series of uncanny reports in the minds of our credulous ancestors. And knowing that we both understood the science of what we had seen I felt grateful that while we may actually behold far greater wonders than the people of 1850 imagined they saw, we live in an age where we do not have to resort to the realms of the uncanny for our explanations.

Lights for a Penny

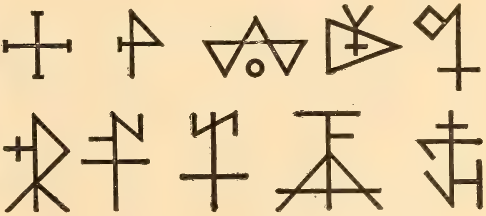
The inhabitants of Zargau, Austria, are not haunted by the colloquialism "afraid to go home in the dark." The village owns the electric light plant and at ten o'clock the street lamps are turned out and connected to an automatic system. In case a villager on his way home after this hour desires the street lighted he deposits a "pfennig" in a box mounted on an iron post at the street curb. Immediately the lamps for several blocks are lighted up and burn for twelve minutes, long enough for the late comer to reach his door.

HE DEPOSITS A PFENNIG IN THE BOX

Fifteenth Century Trade Marks

Now that the use of electrically heated branding irons makes it easier than ever to stamp a distinctive mark on boxes, bags or bales, there seems to be an increased tendency towards returning to this time-honored form of marking. This early form of "trademark" dates back at least seven centuries, for in the Thirteenth Century European merchants began to mark their shipments with distinctive signs by which they could claim them, if lost or if recovered from highwaymen. As the number of traders grew the marks became more complex, a fact readily shown by the adjoining ten which have come down in the Fifteenth Century records of the city library at Cassel. Even stencils were then unknown, hence these symbols had to be laboriously marked with a brush by hand, a task which may easily have taken 50 times as long as the modern electric branding. How the markers of those days would open their eyes if they could see the shipper of today simply slap his branding tool against the case and push the button for a few seconds, only to leave a mark far more intricate than any they thought of using and many times as compact.

TWENTIETH CENTURY BRANDING IRON



SOME FIFTEENTH CENTURY TRADE MARKS

Magnetic Divining Rods

Few superstitions have had more ardent supporters through the centuries than those connected with the divining rod, the simple fork which was so long supposed to indicate the hidden location of water, ore or other treasure. Even Paracelsus who did so much to improve therapeutics four centuries ago strongly believed in it and the Cornish miners who still try it occasionally are not the only remaining ones who marvel at its alleged effectiveness. For water hunting it was usually made of a sprig of hazelwood, freshly cut, the idea being that somehow the sap in it had an affinity for the water underground and would point to the same if the fork was balanced in the hands of a kindly minded person.

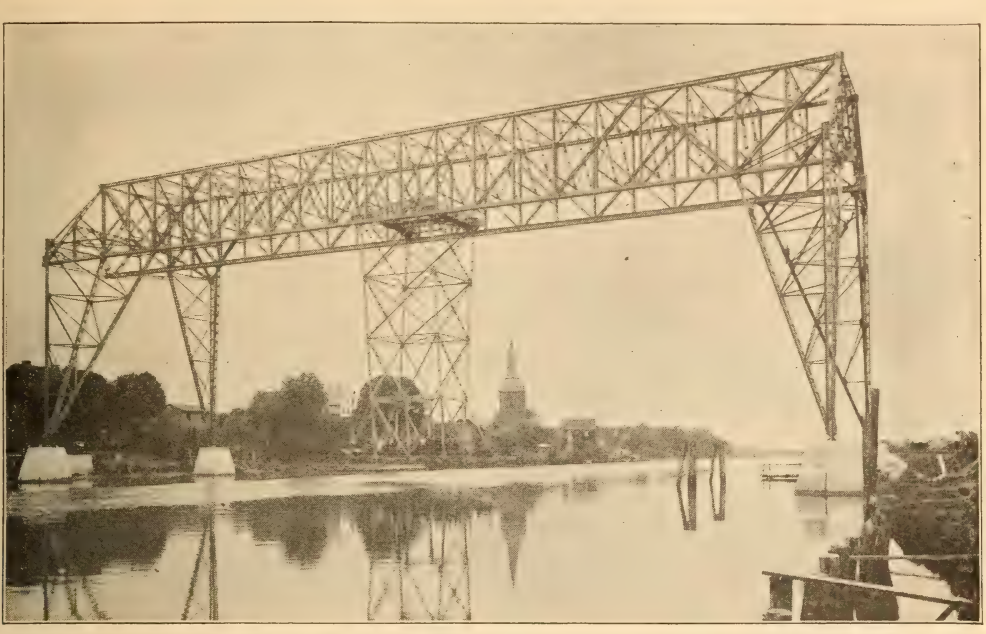
TREASURE HUNTING WITH DIVINING RODS. FROM AGRICOLA'S BOOK OF MINING (1550)

For ore or treasure hunting, the fork was often made of iron so as to allow of some assumed magnetic action. Even Agricola who founded the sciences of mining and mineralogy, believed that some supernatural influence guided this magic wand, so that it would point to ores, as it undoubtedly did when used in districts replete with them. In 1692 it was even used at Lyons in France for tracing a trio of alleged murderers, one of whom was executed largely because the divining rod had pointed in his direction. Later on, the diviner responsible for this peculiar detective work was put to various tests but failed utterly to locate water or ores when secreted near him; neither could his magic wand point out thieves whose whereabouts were known to the police but not to him. This gave a decided setback to the use of the forked wands, from which they have never recovered. Even at that time the wise Father Lebrun, disregarding the claims that magnetism moved the rod, held that the motion of the twig was due either to conscious knavery or to the the unconscious thought of the person holding it; or as a more recent writer has expressed it, to "a strong impression on the mind acting through the agency of the nerves and muscles." This explanation has been so clearly demonstrated by recent physiologists, beginning with Chevreul in 1854, that a continued belief in the alleged magnetic fork must be mere superstition, and yet there are those even in our own country who are still sixty years behind the onward march of science.

An Imbedded Lightning Rod

Instead of erecting a separate lightning rod to protect the 200-foot chimney of a new cement mill at Obercassel in Germany, the builders have utilized the steel rods which run all the way up the concrete of the chimney to reinforce the same. These rods were spliced to each other with special care, connected to a good grounded conductor at the bottom and to exposed iron terminals at the top.

With the present remarkable growth of reinforced concrete construction, this method of using the imbedded steel rods as conductors may easily become a general practice.



SUSPENDED ELECTRIC FERRY AT OSTEN, GERMANY

Suspended Electric Ferry

Given a city where the river traffic must not be cut off by a low bridge and where the cost of either a high bridge or of one that would open for vessels is out of reach of the available funds: what is to be done? This was the problem that confronted the little town of Osten in Germany and the illustration shows the answer worked out by the Maschinenfabrik Augsburg-Nuernberg, it being a suspended electric ferry which can carry two teams and 25 foot passengers across the stream in three minutes. The girder on which the ferry travels is 80 feet above the water, easily clearing the highest masts without shutting off the view as would be done on each side of the picturesque stream by the approaches to even a low bridge. A toll of a cent per foot-passenger and from ten to fifteen cents for teams helps to defray the running expenses and the interest on the investment.

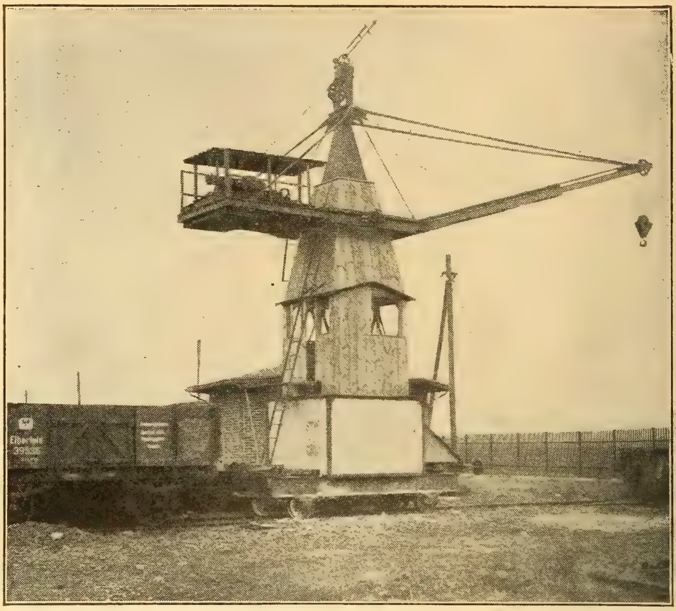
Distributing Morning Papers by Street Car

A mail car is now in use in Chicago to deliver the morning papers to the South and West sides. Just before three o'clock any morning this car may be seen at Clark and Washington streets ready for the trip. The interior of the mail car was altered by removing the mail bag racks and pigeon holes so as to afford plenty of room for piling the papers.

Are Wave Motors Feasible?

Who that has watched the waves swell and break on the open sea, or beat wildly against the shore, has not wished for some way of utilizing this evidently tremendous power? Many indeed are the inventors who have tried to do so in practice, but so far without appreciable success. Now an Italian electrical engineer, R. Salvadori, in an address before the Electrotechnical Society of Italy, makes the claim that wave motors will not pay. He reasons that the number of days on which the waves would swell to a height of even a yard would be less than 180 in a year and that to utilize them and pay interest on the investment would make the power cost much higher than that from fuel. Therefore he thinks it absurd that men should spend any more time in trying to devise a practical means of obtaining power from the waves. Perhaps he is right; but have not similar predictions been made in times past (and often by eminent engineers) to prove the commercial impossibility of the locomotive, the steam engine, the dirigible balloon and the airship?

An Odd Looking Derrick



GERMAN TROLLEY CAR DERRICK

If some of the early Dutch settlers of the Hudson River districts could come to life today and see this electric tower crane, they probably would raise a cry of "plagiarism," for the body of the structure certainly looks as if it had been stolen from an old Dutch windmill. The tower rotates, too, as did the windmills of old, but the twin trolley arms at the top show that wind is not the motive power. It is electricity, taken from two wires stretched above the railway track that operates the motor on the raised platform, thereby lifting and swinging the arm of the derrick. This has a reach of 30 feet and can lift a two-ton load eighteen feet high, so that it could readily load and unload gondola freight cars even if they were American eight wheelers instead of the little German four-wheeled car shown in the illustration.

Emergency Battery for Ships

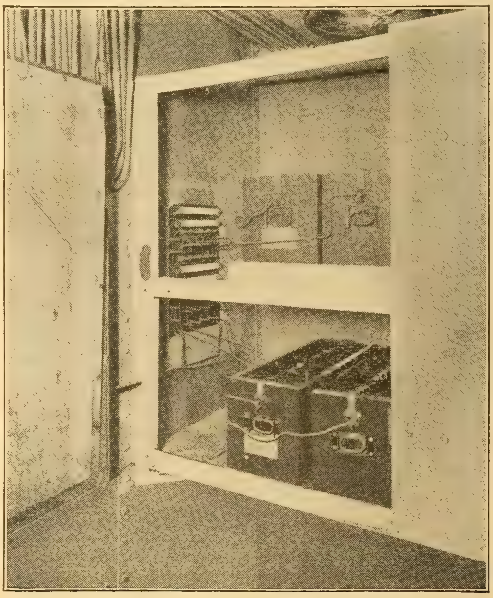
A storage battery for a rather unusual purpose has been made a permanent part of the electric lighting system of the steamship Alabama of the Goodrich line, plying between Chicago and Muskegon, Michigan.

In case of accident to the dynamo or of the sinking of the vessel, the battery is connected to the lights in the corridors and stairways by throwing switches on the small switchboard, the back of which is shown in the battery enclosure in the picture.

The battery, shown opposite, is located at a high point of one of the upper decks so as to remain in service as long as possible should the worst happen.

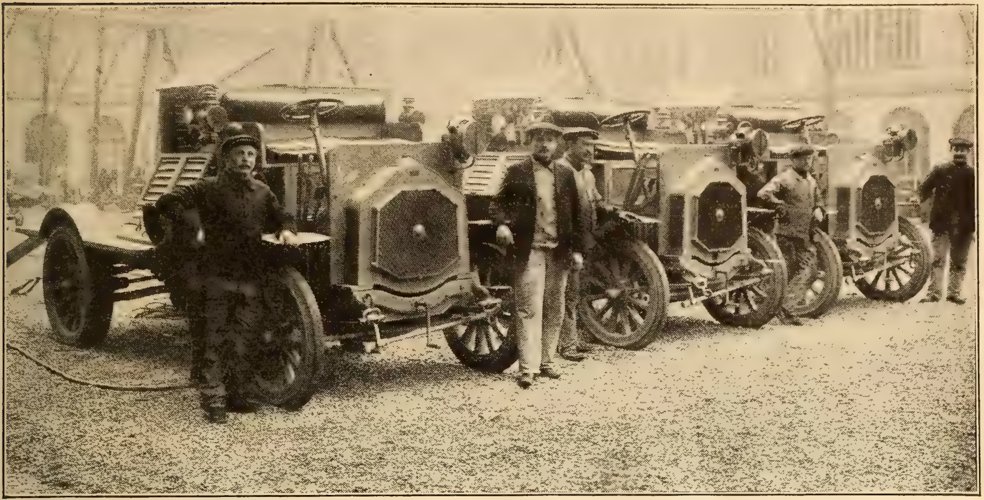
The battery is charged during the day and used for lighting after the generators are shut down at night. The installation consists of 56 cells which on one charge will supply current enough to keep the 25 four-candle-power 110-volt carbon lamps here used burning for ten hours.

The Electric Storage Battery Company, which installed the system, rates the output of this installation as 4.5 amperes for eight hours.



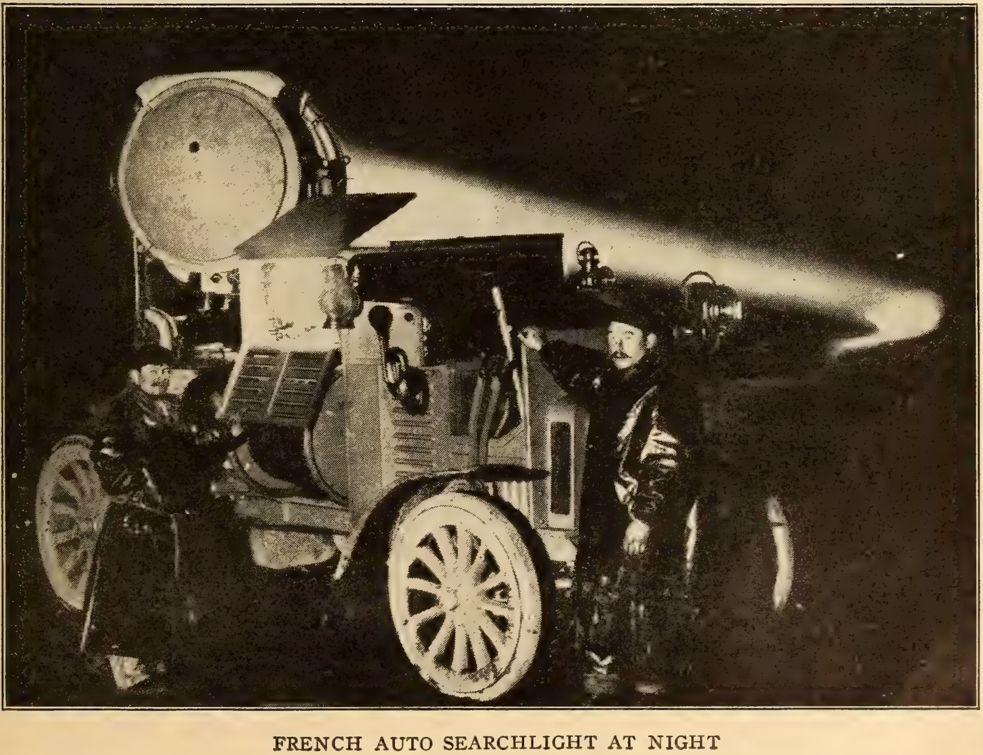
EMERGENCY BATTERY FOR SHIPS

AUTO SEARCHLIGHTS IN FRANCE



THREE OF THE FRENCH AUTO SEARCHLIGHTS READY FOR ACTION

In the September issue of POPULAR ELECTRICITY was shown an automobile searchlight which is being tried out in the United States Army. The French are also experimenting along the same lines, and the upper illustration shows three of their electric searchlight autos ready for the field. What they are able to do with



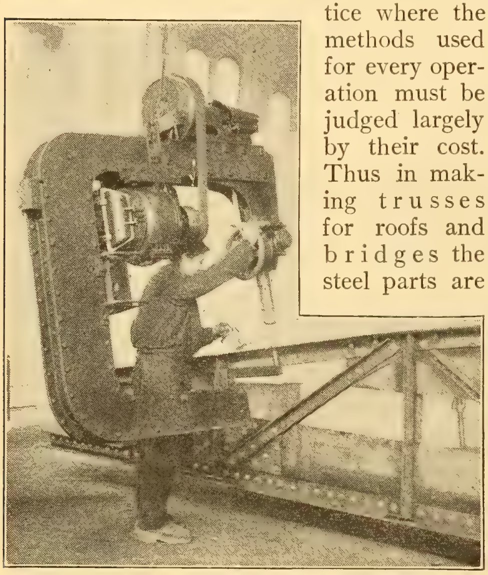
FRENCH AUTO SEARCHLIGHT AT NIGHT

it in the night may be judged by the lower picture.

Each of these automobiles is equipped with a gasoline motor of eighteen horsepower capacity capable of driving the vehicle at a speed of eighteen miles per hour, and is able to climb grades of twelve to fifteen per cent without difficulty. A separate gasoline motor on the car drives the dynamo which furnishes current to the searchlight arc lamp. These lights are very powerful, several thousand candle-power in fact. They are carried on separate trucks and can be operated at a distance from the main automobile by means of long insulated cables which bring the current to them.

Suspended Electric Drill

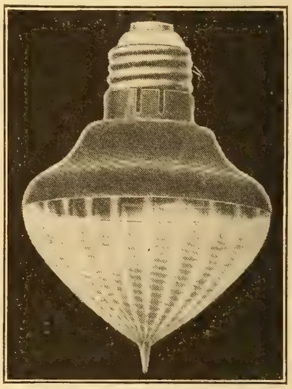
"If the mountain will not come to Mohammed, the prophet must go to the mountain." The same applies to tools in modern practice where the methods used for every operation must be judged largely by their cost. Thus in making trusses for roofs and bridges the steel parts are secured to each other by a large number of rivets for each of which rivets a hole must be bored through two or three different pieces. To mark the location of the holes in each piece accurately and drill each separately is a tedious job. Assembling them first and drilling through the adjacent steel parts at one operation would save a good deal of time, but this usually means too heavy a mass of metal to move along the drill press from hole to hole. If the drill could be moved instead the problem would be solved and indeed is solved, even to boring through sloping plates, as shown in the illustration. This pictures a massive portable drill weighing nearly a ton and fully as powerful as stationary machines for this class of work, yet readily shifted about by the traveling crane from which it is hung. The heavy soles of the workman show that this a German shop, and even among the stolid Germans such labor-saving electric devices are appreciated and used to good advantage.



SUSPENDED ELECTRIC DRILL

A Jewel-shaped Lamp

The ease with which glass may be blown into any desired shape makes it possible to produce lamp bulbs in a never ending variety of fantastic as well as ornamental designs. One of these, originating in Holland, has a bulb with facets imitating those of a cut jewel. The metal mirror which slips over the neck of the bulb can be striped to accentuate this facet effect.



LAMP THAT LOOKS LIKE A JEWEL

Glass Not Always Insulating

The common use of glass for the petticoat insulators which are seen on electric light, telegraph and telephone poles shows that glass is one of the best of the inexpensive insulating materials. But those versed in electrical practice know that only certain mixtures of ingredients will produce a glass of high insulating quality. Particularly must lead be avoided, else the insulation may be considerably reduced. How much this can be done has been shown by E. S. Philipps who finds that by adding both oxide of lead and antimoniate of soda to the ordinary ingredients (borax and silicate of soda) he can produce a glass a thousand times as poor in insulation as that commonly used in electrical practice.

FOR PRACTICAL ELECTRICAL WORKERS

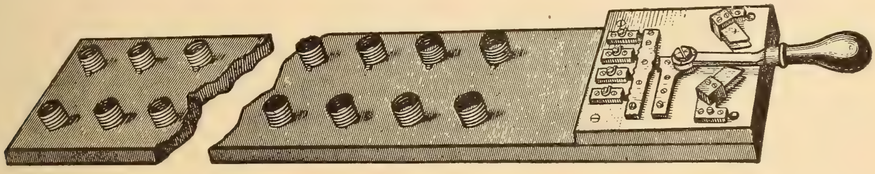
HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

Testing Electrical Apparatus a Quarter of a Century Ago

By **W. S. ANDREWS**

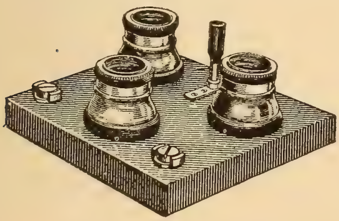
It may be interesting to look back about 25 years and briefly review some of the facilities which were then available for the electrical testing of dynamos and incandescent lamps.

The writer was superintendent of the testing department of the Edison Electric Light Company in New York from 1881 to 1883, with headquarters at the Edison Machine Works in Goerck street, and the present paper will refer chiefly to the means and methods which were in common use there during that period.



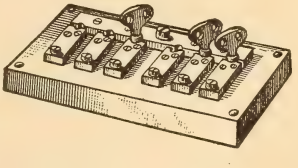
TEST BANK OF 50 SOCKETS FOR INCANDESCENT LAMPS

Only low tension direct current bipolar dynamos were made at that time for incandescent lighting service, and their capacity was indicated by the number of 16 candle-power incandescent lamps they could carry without undue heating. Thus the Edison bipolar dynamo was styled a 60-light machine, the "L" a 120-light machine, the "K" a 240-lighter, and so on. In testing these machines, they were connected to the proper number of lamps, and operated at normal voltage for a specified time. The 16-candle-power incandescent lamp of that period dissipated about 80 watts.



GROUND DETECTOR

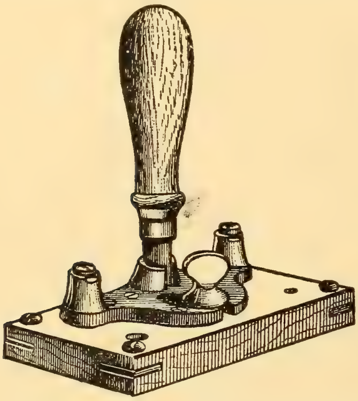
A "standard battery" consisting of about 50 cells containing copper-zinc couples was used to determine the voltage. The copper strips were immersed in a saturated solution of chemically pure copper sulphate in distilled water and contained in porous cells, and the zinc strips were amalgamated and immersed in a saturated solution of chemically pure zinc sulphate in distilled water placed in the outer containing jars. The theoretical electro-motive force of this couple when newly charged and in good condition was rated at 1.079 volts, so a battery of 50 couples developed about 54 volts. This battery was connected in series with a "Thompson" reflecting galvanometer and an adjustable high resistance of about 100,000 ohms, the resistance being regulated until the battery produced a deflection of 54 or 108 degrees, or one volt for one or two de-



LIGHTNING ARRESTER SWITCH

grees on the galvanometer scale as the case might be. The galvanometer, with high resistance in series with it was then switched over from the standard battery to the dynamo, the potential of which was read off directly in volts. There was also a heavy and roughly made Deprez galvanometer in the testing room, but it was found necessary to re-calibrate this instrument frequently with the standard battery and reflecting galvanometer, in order to insure correct readings, so that its use was limited to rough work.

The candle power of the incandescent lamps was found by comparing the light of a lamp at normal voltage with that of a standard candle in a Bunsen "grease-spot" photometer. The standard candle was rated theoretically to burn 120 grains of tallow per hour and the candles were occasionally weighed to see that they actually consumed the proper amount of tallow.



OLD STYLE PLUG SWITCH FOR "FEEDERS"

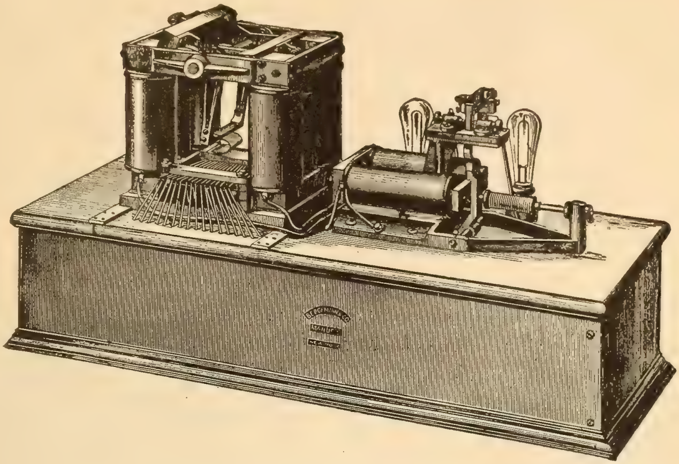
In the early 80's of the last century the unit of current was termed a "weber," this name being changed to ampere about 1885-6. Later on the electrical unit of power became popularized. It was named the "volt-ampere," and afterwards changed to the "watt." Edison dynamos were rated in 16 candle-power lamps, however, as late as 1890, but in this year it became common practice to rate them in watts or kilowatts. At that time (1880-83) we had no instrument equivalent to the modern ammeter, and the process for determining the "webers" involved the use of the reflecting galvanometer. A strip of metal, generally German silver, of measured resistance, was interpolated in the circuit, and the drop in volts across its terminals was read in the usual way on the scale of the reflecting galvanometer. The resistance of the shunt and the drop in volts being thus known, the webers were calculated. To save time and labor, it was usual to calibrate the reflecting galvanometer in connection with the German silver shunt so that webers could be read directly on the galvanometer scale without any calculation. A "shunt-box," containing a dozen large sheets of German silver, was used for measuring heavy currents. This box was about 40 inches long by 15 inches wide and 12 inches deep. The German silver sheets were stretched from end to end and means were provided for connecting them singly or in multiple so as to obtain various resistances and current carrying capacities.

I am not aware that any particular improvememt has been made since these pioneer times in the measurement of electrical resistance. We had then, as now, the reflecting galvanometer, and the Wheatstone bridge made by first-class firms, such as Elliott Brothers, London, and Bergmann & Co., New York, so that electrical resistance could be readily and accurately measured. We were, however, as before stated, woefully lacking in handy and convenient devices for indicating current and potential. In view of this fact inquiry may very naturally be raised concerning the regulation of voltage and life of lamps in small isolated plants and central stations at that time.

Strange as it will appear in the light of all our modern refinements, the only means of maintaining normal voltage in many small isolated plants was observing the so-called "pilot-lamp," which was located on the head-board of the dynamo. The attendant was primarily instructed as to the normal brightness of this lamp and told to maintain it as nearly as possible to proper incandescence by regulating the field excitation.

LIGHTNING ARRESTER

In larger plants, "pressure indicators" were used. These devices were so constructed that the lighting up of a red or a blue lamp indicated "high" or "low" volts respectively, voltage being normal when neither lamp was lighted. I believe that the voltage in the Pearl Street Station of the New York Edison Company was regulated for some time by these red and blue lamp indicators, and a gentleman now prominent in electrical circles may possibly remember carrying the heavy Deprez galvanometer on his shoulders from the Goerck Street testing room to the Pearl Street Station once or twice a week, by which to set the indicators above referred to. It was not considered safe to transport the Deprez galvanometer in a vehicle as the slightest jar might put it out of adjustment.



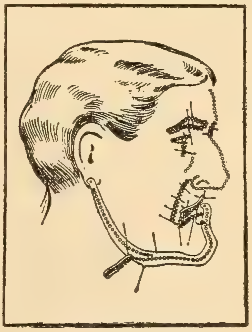
EDISON AUTOMATIC REGULATOR

In large isolated plants "Edison automatic regulators" were sometimes used, but these devices often did more harm than good, as they lifted a certain amount of responsibility from the shoulders of the attendant, and thus tended to make him less watchful. This automatic regulator was also a very expensive device and in small plants it sometimes cost as much as the dynamo.

In 1883 the writer was appointed by Mr. Edison to superintend the installation of electric apparatus in the Edison three-wire central stations, which were then in process of construction in different parts of the country. The only indicating devices used in the first of these stations were two-volt indicators, which had to be frequently standardized, and an ammeter in the neutral bus-bars to indicate if the system was out of balance and to what extent. The above equipment, with slight variations, was copied in most of the small stations, about twelve of which were installed during the year following July 1st, 1883. Most of these small stations were furnished with one pair of dynamos to operate on the three-wire system. The extension of the lighting business, as time went on, naturally led to the use of more dynamos, which were connected in multiple with those already in service. The necessity of individual ammeters for each dynamo was brought forcibly into notice by the burning out of armatures from excessive overload, there being no visible means for correctly distributing the total load. This necessity led to the development of the so-called "pendulum" ammeter, and the first six instruments of this class were set up in the Edison Station in Cumberland, Maryland, in 1885-6. After this date, central station indicating devices were improved and multiplied from time to time as new requirements developed.

Facial Expression Electric Sign

A most ingenious use of lines of lights for changing the expression of the human face in an illuminated sign is the invention of a New Jersey man. The sign as a whole consists of incandescent lights forming a human face and the lamps are so arranged that they can be moved independently of each other. In this way joy, sorrow or anger may be expressed by moving the eyebrow and mouth lamps and at the same time the position of the lines of the face as from the nose down may be altered. This idea developed into commercial use would probably be in demand as a decidedly effective "Before" and "After Taking" advertisement for Jag's Whiskey, or Gump's Gum.

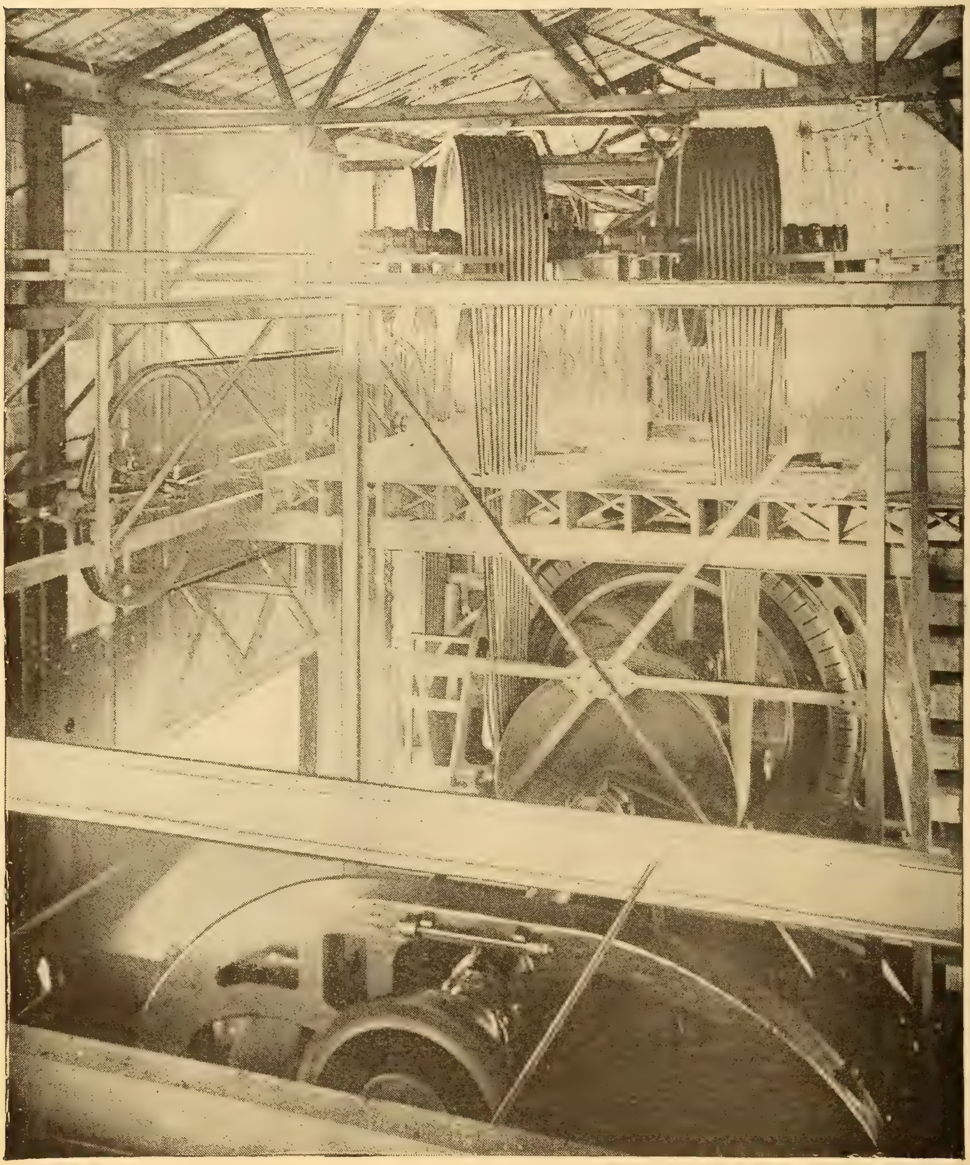


ELECTRIC SIGN

How a Dynamo is Driven by Ropes

It may almost be said that the Economy Light and Power Co. of Joilet, Ill., makes electricity out of the sewage of the City of Chicago. Surely, if this be so, it is entitled to the "Economy" part of its corporate title. The plant is located on the Illinois river, into which the Chicago drainage canal conducts the sewage of the city diluted with water from Lake Michigan

The Economy plant had its inception many years ago and has grown to great size by occasional extensions as power and lighting loads have increased. The company now carries practically the entire lighting load of Joliet and vicinity, and drives the machinery in many of the large industries of that district. Constant growth of business



DYNAMO OPERATED BY ROPE DRIVE AT JOLIET, ILL., POWER PLANT having increased the total load beyond the limits of the water power available, the company has installed an auxiliary steam plant, using steam turbine-generators.

In the down-stream end of the long main building of the water power plant is the equipment for generating direct current. In an extension at this end of the plant was installed some years ago a 375-kilowatt (500 horse-power) alternating current dynamo driven by two 200-horse-power water wheels. This unit was entirely independent of the equipment in the main building adjoining. The two water wheels have a combined horse-power rating of 400, whereas the generator requires 500 horse-power to develop the full rated capacity of 375 kilowatts. The water wheels, therefore, are insufficient to drive the generator up to full load, to say nothing of carrying overloads.

In recent years the direct current load has decreased and the alternating current load has increased. Increase of the alternating current load has made it desirable that this 375-kilowatt generator be operated up to capacity and be made to assume its share of overload when required. The decrease of direct current load fortunately made available a surplus of power in the main plant. To utilize the surplus of power from the main line to assist the two water wheels in driving the alternator, naturally suggested itself as a way out of the difficulty.

But this "way out of the difficulty" imposed difficulties of its own—difficulties which to some folks would seem practically insurmountable.

There appeared to be little in common between the main line and the generator line. They seemed to be different in every possible way. The shafts differed in line and level; they differed in diameter; they differed in speed; they differed in direction of motion.

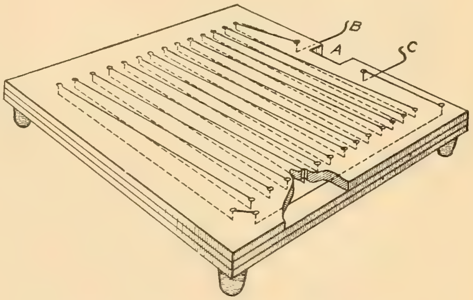
The problem was however solved by driving the dynamo with ropes, upon the Dodge American system. A driving sheave was fitted to the main line, extended into the dynamo room. From this driver the ropes lead upward, over suitably placed idlers, and thence down directly to the driven sheave on the dynamo shaft. The tension equipment is nicely accommodated on a horizontal track, conveniently placed along the side of the room, quite out of the way. Thus sufficient power could be brought by the rope from the main shaft in the power plant to the isolated dynamo, which, in addition to the power already there could drive the dynamo up to 40 per cent overload.

Portable Electric Heater

The electric heater here described by the builder was found useful in heating the shaving water and keeping dishes hot on the tea table. The material necessary is as follows:

Two pieces ¼-inch asbestos, 6 by 6 inches.
One piece of mica, 6 by 6 inches.
One piece of asbestos board, 6 by 6 by ¼ inches.
Twelve feet No. 20 Climax resistance wire.
One piece of sheet brass, 8 by 8 inches.
Four feet of heater cord.
One attachment plug.
Four hard rubber knobs for base.

On one of the pieces of asbestos draw a five-inch square, leaving a margin of half an inch as in the sketch. On two opposite sides punch fine holes about ⅜ inch apart and string Climax wire as shown. At (A) cut out both pieces of asbestos so that the cord may be inserted. On the bottom of this place the other piece of asbestos and below that the asbestos board, while on top of the asbestos containing the wire place the six-inch square of mica. The sheet brass may then be placed on top and drawn over the side and tacked to the asbestos board.



PORTABLE ELECTRIC HEATER

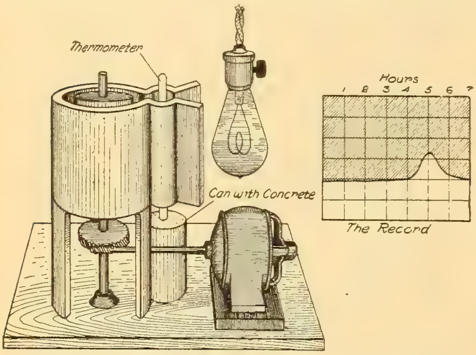
At the end (A) cut the brass and insert a bushing. Through the bushing run the heater cord and solder its ends to those of the iron wire, while on the other end place an attachment plug. On each of the underneath corners tack a rubber-headed tack and the heater is ready for use.

—Theron P. Foote.

Timing Concrete Electrically

While it is important that the moulds used in structural concrete work shall not be disturbed until the concrete has thoroughly set, it is also important that no time shall be wasted after the mixture has thoroughly hardened. To judge this time safely requires a knowledge of the time required for each mixture to set. Guess work might be costly and misleading, and the actual time can now be recorded photographically by the simple device shown in our cut.

This is based on the fact that when concrete "sets" there is a sudden rise in its temperature. If a thermometer is inserted in the mixture, the mercury will suddenly jump up when the concrete hardens, hence an easily timed photographic record of the temperature will tell us the "speed" of the concrete. To get this, a sheet of photographic printing paper is wrapped on a drum which is very slowly rotated by an electric motor. Surrounding the drum is a cylindrical casing having a narrow opening at one edge through which the light of an incandescent lamp can shine on the sensitive paper. This slot is so narrow that the mercury in a thermometer tube will close it against the light, so that the paper will record only the light passing through the glass tube above the top of the mercury. In practice, the bulb of the thermometer is set into a small can of the concrete mixture which is to be tested, the bulb being first coated with several layers of wax dissolved in benzine, which allows it to be removed after the concrete sets. Then the motor is started and the hourly time marked through the slot with a pencil. The result is a record of the hourly time and of a sudden temperature variation which tells when the concrete sets. By placing the lamp in series with the motor its normal speed is greatly reduced, thereby adapting it better to the slow pace needed for this purpose.

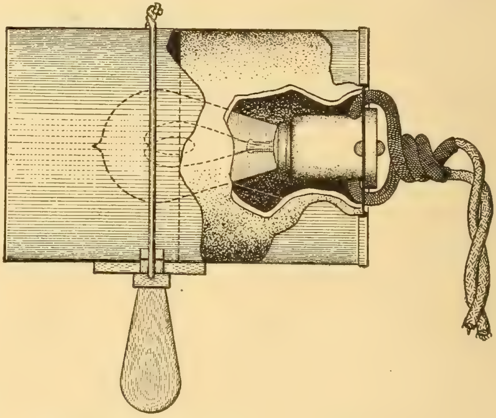


APPARATUS FOR TIMING CONCRETE

Earache Cured by Lamp

In the early days when such a thing as an electric warming pad or an incandescent lamp was a curiosity, father's pipe served often to ease the pain of an earache. A cloth was placed over the bowl of the pipe and the stem directed into the ear. By blowing through the cloth he was able to force the smoke and hot air into the ear, often allaying the pain.

The illustration shows how to build a simple home made device, using an electric lamp, for the same purpose; that is, to convey warmth to the ear. In the bottom of a tin can large enough to hold an electric lamp and socket, make two holes about $1\frac{1}{2}$ inches apart and large enough to pass wires through, having "loom," an insulating material, upon them. A hole may also be cut out for the base of the porcelain socket to project through, or this base may be held against the bottom of the can by drawing the wires tight on the outside. A circle of asbestos as shown may be placed in the lower half of the can and a wooden handle secured perpendicularly to the side by a bare No. 14 copper wire. By connecting the device to a lamp socket with an attachment plug and holding the open end of the can over the ear the afflicted member will usually soon yield to the confined warmth.

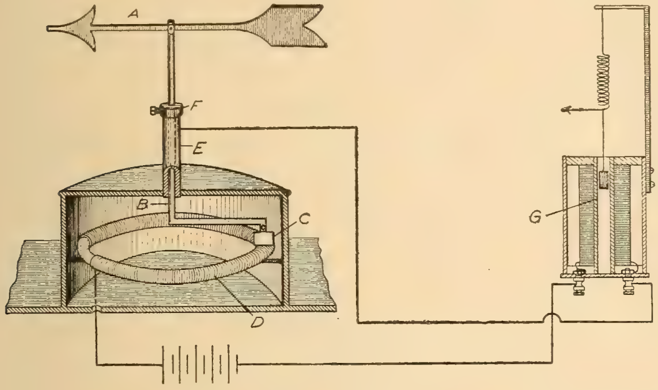


ELECTRICAL DEVICE TO CURE EARACHE

Horace A. Weddell.

Wind Vane Indicator

I submit the following sketch and suggestions for making an electrical wind vane. Referring to the illustration, (A) is the vane proper, which should be about six feet long. (B) is a small shaft or axle which revolves when the vane turns around, and on the end of the arm of which is a copper or brass brush (C). The brush is so arranged that it is always in contact with (D), which is a circular piece of wood wound with German silver wire and supported by hard rubber or wooden pins. A small pipe (E) which just fits the shaft (B) is provided with a brass collar (F) which keeps the shaft in the proper position.



WIND VANE INDICATOR

Referring to the indicator, (G) is a tube of thin brass about $\frac{1}{4}$ inch in diameter and four inches long. This is wound with ten layers of fine copper wire with the terminals attached to binding posts. A plunger is made of a piece of soft iron and soldered to a piece of copper wire having a spring soldered to its upper end. The spring is secured to a support as shown. A small pointer is soldered to the copper wire. The whole may be put in a neat case in which there is a slot through which the pointer extends.

When connected up, the device is calibrated by moving the vane to the different points of the compass and marking on a scale the places where the pointer comes to rest each time. The action is as follows: When the brush moves over the resistance wire it allows more or less current to flow by varying the amount of wire in the circuit, and this current in passing through the coil pulls the core with more or less strength, on the principle of the solenoid, moving the pointer up and down the scale. —Dallas Wood.

Utilizing Old Dry Batteries

As I am a young student of electricity and chemistry I know the ever present desire of most experimenters to construct things just for the fun and experience they can derive from them. For their benefit I describe an easy method of utilizing old dry batteries so as to obtain more current from them. These can often be procured from the telephone man for a few cents or for the asking.

Remove the outside paper covering from battery and with a knife and a small hammer separate the zinc where it is soldered. Carefully remove the zinc from the outside paper cover which contains the carbon element. Wrap a strong cord around the carbon and case to prevent spilling. Straighten the zinc out flat and scrape most of the deposit off, then curl the zinc up so it will fit the carbon element just as it did at first, then set the whole thing in a jar that will contain about a pint of water after the battery has been placed therein. After the battery has been in the water about ten minutes it is ready for use.

No chemicals are put in the water because they were in the original battery and from lack of moisture became inactive. For the jar I find a wide-mouthed fruit jar to be the best.

Roy A. Bradt.

Dry Battery Paste

To make a dry battery paste use plaster of paris, one pound; oxide of zinc, one-quarter pound; saturated solution of chloride of zinc, sufficient with the above material to make a thick paste. Provide a carbon stick (arc lamp carbon) to place in the center of a zinc box, insulating the carbon from the bottom by a piece of fiber. Around the carbon fill in with closely packed paste. The zinc forms one pole of the cell and the carbon the other pole.

Fifty Kilowatts of Water Power

By WARREN H. MILLER

It was more years ago than I care to remember, that the construction and layout of that little hydro-electric plant, with its half mile of transmission out of the virgin forest, was one of the most enjoyable experiences that any budding young electrical engineer could wish for. My field headquarters was a large tree, out in the middle of the construction line—a blessed relief from the grime and noise of the works—and the job itself gave one a virtual holiday of three or four weeks out in the green woods and along the brawling banks of the river.

Most industrial companies have an astonishing way of growing. One no sooner gets enough power provided for them than a new shop is run up, and the already overloaded powerhouse is either called on for more, and yet more, or else power must be brought in from somewhere else.

Now our powerhouse was already groaning under its burdens, and had been for several years, and every boiler was being pushed to the utmost; yet there would be at least a hundred more horsepower needed for heating with the coming of winter. So that, when the new forge-shop was built and about 50 horse power of motors installed, it was the last straw to the camel's back. It was possible to worry along through the summer, but with the arrival of cold weather, something would have to shut down unless more power was miraculously produced.

It happened that the company owned an old mill, down along the river about a quarter of a mile in a direct line from the power house, and, as a last forlorn hope, the writer was sent as a scout to report on what the possibilities were of using any part of its water-power equipment to help out. The old place was utterly given over to Nature when I penetrated through the briers and weeds of its abandoned penstock. Some former extra-high spring freshet of the river had swept away the dam, every vestige of the old overshot water wheel and all the big timbers and underpinning of the mill. About all there was left to report on was nine feet of available head and a volume of about 6000 cubic feet per minute pouring through the ruins of the dam. The penstock was also in pretty fair shape, as it had simply acted as an immense trough during the flood.

Now 6000 cubic feet a minute is roughly 100 horsepower, falling through nine feet, a figure not to be sneezed at. Any good turbine will realize some 85 per cent of this theoretical horse power, and we had in our power stock an extra 40-inch wheel, which would deliver 78.8 horse power on a nine foot head.

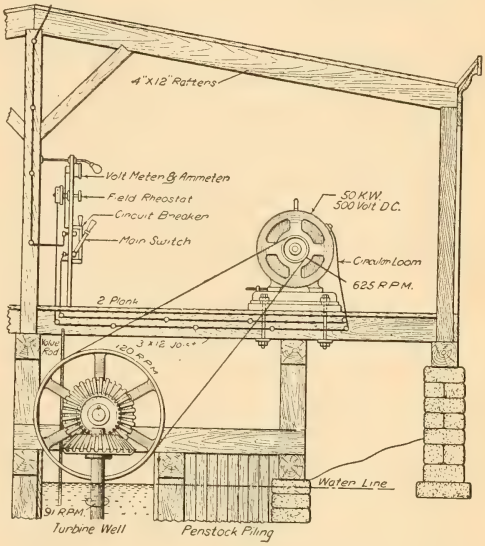
To repair the dam meant simply closing the upper race gate, putting some new planking in the breach and teaming in gravel enough to bring the earth fill back to equal the original section of the rest of the dam. From the electrical department of the works could be had a 50-kilowatt, 500-volt direct current dynamo at cost price, transferred on the company's books, so the real expense of getting the power question solved would not run into any great figure. The writer was ordered to get out an estimate and figure up a little transmission line to deliver 50 kilowatts at the main switchboard at 500 volts. It should be explained right here that such current could not be put in on the main bus bars of the power house dynamos, for these were all compound-wound machines, with the series coils of the fields connected by equalizers. As the equalizer must at times carry the full output in amperes of the machine, this would mean, not two wires, but *three* of full size on the transmission. So a separate lead always had to be found for the new dynamo, which was easily done, one double-throw switch giving us the choice of two shops.

The first care was the repair of the dam and the building of a turbine-well below the old penstock. The well was simply a large wooden box with the turbine at the bottom of it, sheathing of 4 by 12 inch yellow pine, and timbers figured to stand the static pressure of nine feet of water. The turbine was of the inward-flow type, with a vertical shaft turning at 91 revolutions per minute. It discharged out of the bottom of the box directly into the tail-race, and the admission was controlled by a sliding gate-ring that simultaneously closed all the inlet ports to the turbine vanes, shutting them all off in about three inches of travel. This gate was manipulated by a rack-and-pinion with vertical valve-rod on one side of the turbine, and a turbine governor.

With the turbine were two main bevel gear-wheels of cast iron with hard maple teeth, the one on the vertical turbine shaft having 54 teeth and the other having 40. This would make the revolutions of the main jack-shaft 120 revolutions per minute. Now, as the speed of the dynamo was 625 revolutions per minute, a pretty slow speed for that size machine, but the slowest obtainable in stock sizes, the problem would be how to best get from the 110 revolutions of the jackshaft to the 625 of the dynamo. Naturally the best way would be to belt direct to the dynamo, because the belt in any event would have to be not much less than 14 inches wide, and a countershaft-rig with such large belts could hardly be located anywhere on the mill timbers without building a special trestle for it. The main jackshaft would also have to go on the strong 16 inch timbers which formed the heavy foundation-work of both mill and penstock, and these with rigid pillow-blocks would bring the main shaft about 37 inches above the surface of the water in the turbine well. This would permit a 72-inch wheel on the jackshaft and would therefore call for a 14 inch pulley on the dynamo. Such a pulley, going at 625 revolutions, or 35 feet a second, would have to be fifteen inches wide since a double leather belt at that speed will transmit approximately seven horsepower per inch of width; and therefore a fourteen inch belt would give 98 horse power. This would develop the full strength of the wheel and allow something for overloading the dynamo, say 25 per cent.

Following this line in preference to any countershaft alternative, the dynamo was located, as shown, on the main floor of the old mill, the belt passing through the floor to the 72 inch wheel below, the distance between centers being fifteen feet.

It is essential to keep the speed of the dynamo constant, because the steadiness of the voltage depends in a great measure on the speed, and it must remain the same whether the load is light or heavy. Now the waterwheel tends to race on light loads and slow down to its normal on heavy ones, so it must have a governor to close its gates as the load gets less, and thus hold the speed steady. The one shown on the next page is what is known as a compensating governor. In order to make it delicate enough, the valve-turning mechanism must be governed by the small balls which change their position due to variations of the speed. It will not do to have the centrifugal ball mechanism act directly on the valve rod, and as it has but a very small travel for the minute changes in load. Therefore the governor balls simply alter the vertical position of the two cup-shaped friction discs (A). Inside of them rotates a solid disk driven by the large twelve inch pulley, and there is a scant 32 inch clearance between the faces of this disk and the cups which enclose it. If the governor ball mechanism raises the lower cup ever so little, it at once comes in contact with the interior disk, which is always spinning around, and so it goes around with it and thus turns the gate-valve rod by the gears shown on the rod. If, on the other hand, the governor ball mechanism lowers the upper cup a very little, *it* comes in contact with the interior disk and thus actuates the valve-rod in the opposite direction. So therefore there is only one position in which the valve-rod is left alone, and this is at the normal voltage-speed of the dynamo. The least variation from this speed calls the disks into play and the gates are opened or closed a trifle. With steady loads there is little for the governor to do, but with constant variations, such as with certain shop loads,



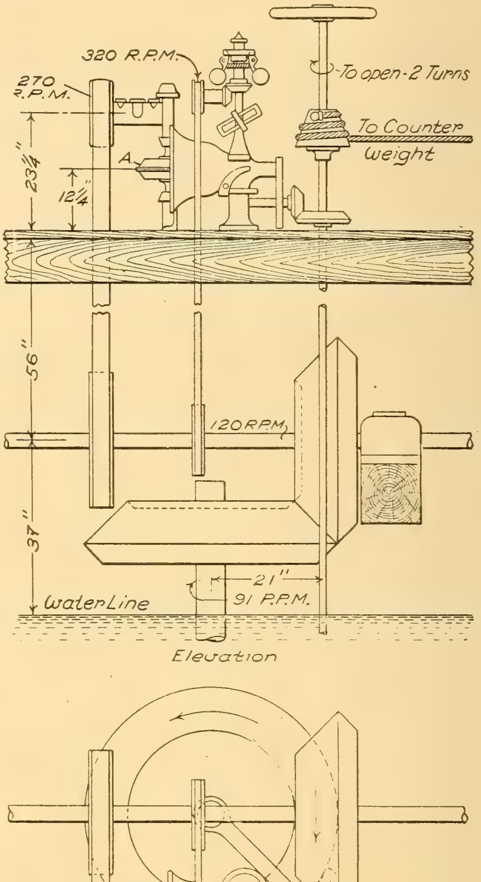
POWER PLANT SHOWN IN ELEVATION

the governor is incessantly making slight changes in the position of the gates.

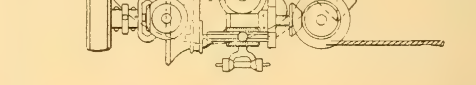
With a steady run of five teams building up the dam, and all orders placed for governors, dynamo, pulleys and belts, the next thing to go at was the transmission. Actual measurement of the distance showed it to be 1400 feet from the mill to the central power-house. At 50 kilowatts the amperage would be 90 for 550 volts. To arrive at the most economical size of wire to get this 90 amperes over to the central power house, you must realize that in any transmission there are *two* losses—the horsepower loss, due to line-drop, and the interest on the money invested in the wire. Obviously the wire in which the sum of these two losses is the least is the size we want. For instance let us assume a line loss of ten percent. As a kilowatt is worth roughly $20 a year, the power loss would then be 5 K W,x$20, or $100. Figuring the wire for this loss, we use the well-known wiring formula: Circular mils$=\frac{10.8 \times 2 d \times A}{v}$

where v is the drop in volts, A the amperes, 10.8 the resistance of a mil-foot of copper wire, and 2d twice the distance in feet. This gives 101, 000 circular mils, or No. 0 wire, weighing 319 pounds per 1000 feet. The total weight would then be 900 pounds, which at 20 cts. a pound would amount to $180, and the interest on this at 12 percent would be $21. You see, the interest is taken at what the same capital is worth on manufacturing account to the works, not at six percent, the amount it would command in a bank. So the total loss per year for this size wire would be $121. Suppose we halve the power loss and double the size of wire to No. 4-0. The yearly power loss would then be $50 and the interest loss $42, making the total $92, a saving of $29 a year. But it would involve heavier poles, heavier bracing, more construction expense and double the drain on the amount of money the works cared to spend on the plant, so that the $29 stood in good chance of being wiped out. As we already had in stock over 1500 feet of bare No. 0 which might never otherwise be used, the whole line was put up in this size.

The poles were spaced 125 feet and were all of western cedar, eight inches at the top and fifteen inches at the butt. It is essential to get as few and as straight ones as possible, for every pole out of line requires guying. Selecting the poles with this consideration in mind, they were all tarred for seven feet from the butt, and set six feet in the ground, the total length being 35 feet. A gang of six polemen set them all in one day. One man attended to the butt, guiding it down into the hole with a stout plank set in the hole, another managed the "jenney" or mule, a cross-shaped rest on which the pole could rest as the men stopped to get a fresh hold on it; two men had twelve foot pikes and two eighteen foot. Before raising, the poles were all gained with two notches $\frac{5}{8}$ inch deep, and the two-pin cross-arms bolted on, one eighteen inches below the other, each having two 22 inch flat galvanized iron braces. The



Elevation



Plan

THE GOVERNING ARRANGEMENT

pins were the standard 1½ by 9 inch locust pin for extra heavy cable insulators. They are stiffer than wrought iron pins, and will break off short instead of bending over if too heavy a strain is put on them.

To get No. 0 solid wire up straight and smooth, it is first payed out along the ground beside the poles. It will be found to be full of dog-tails and kinks, due to so much handling. Secure one end of it to the butt of the first pole and stretch about two poles of it with heavy tackle with all the gang pulling on it. They will not only straighten it out but put a set in it. A climber on each pole then lets down a hand line and hauls it up and over the saddle of the insulators. It can then be tautened with a cable-grip and tied in with about No. 6 ties. The poles will not stand the strain of attempting to take out the kinks up on top of the pole, and if you do the line will look amateurish.

The come-along for use up the poles was a No. 0 Buffalo grip, but, without it, simply braiding the handline over the wire to form a "slip" will answer. At all corners the poles must be guyed with ⅜ inch galvanized iron stranded guy-wire. For anchors we used short billets of wood, buried four feet in the ground with a ¾ inch rod and eye coming up out of the earth to take the end of the guy wire. At both ends of the line the cross-arms were doubled and the wire terminated around both insulators, and taps taken off for the mill and power house.

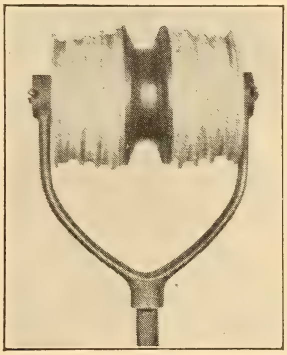
On crossing into the works, we had first to go over the Michigan Central tracks, and then a four-foot water-wheel race 150 feet wide. To go over the tracks, one would have to "sky" the line six feet over the telegraph lines on both sides of the tracks, and the 150 foot stretch over the race was rather long for comfort, so I avoided them both by going down the last pole beyond the tracks with a lead-sheathed twin-cable into a three-inch drain tile conduit laid in the railroad ballast. This cable crossed on the bed of the race, being iron-armoured while under water, as the ordinary lead cable will soon get full of pinholes and grounds under water. The reason we could not cross on posts driven into the race was because of the winter ice, which will pull up any pole. At night the water is low and still, so it will freeze around the posts and bring them up next day when the race is full.

The final point to be constructed was the switchboard at the mill end. This needed a 600 volt voltmeter, a 150 ampere ammeter, a 100 ampere double-pole circuit-breaker, a 150 ampere double-pole knife-switch and a 300-ohm field rheostat. We had in stock an old two inch slate panel, 30 by 72 inches and as full of holes as a sieve. For all that, it was plenty good enough. We filled all the old holes with neat cement and gave it a coat of black shellac—"satin finish" the switchboard people call it—drilled new holes for our instruments with an ordinary brace and twist-drill, and soon had it set up and connected to dynamo and line. The plant went off very nicely, and is running yet for all I know. We had to build a sort of boat under the big pulley on the jackshaft. It only cleared the water by an inch, and the foam and vapor from the turbine well soon began to warp it, being a built-up wooden pulley. But, with the sheet iron guard there was no trouble.

With the arrival of the following spring we had to protect the line with ironclad, line lightning arrestors at every fourth pole, grounding to an iron pipe by a No. 6 ground.

New Device Keeps Trolley On

The exclamation "trolley's off" may be relegated to the back of the dictionary with the terms marked "obsolete" if the device here shown accomplishes all that is claimed for it. The device consists of a sort of right and left-handed threaded roller placed on each side of the trolley wheel. In case the trolley leaves the wire the latter is caught in one of the spiral grooves and returned to the trolley wheel, the current being on during this time. Many accidents and collisions have occurred with sometimes injury and loss of life when the trolley leaves the wire. The Universal trolley retriever is intended to prevent all such accidents and is made so that it may be applied to old trolley wheels on any system.



A TROLLEY WHEEL WHICH IS EASILY KEPT ON THE WIRE

Insulating Materials

CAOUTCHOUC (INDIA RUBBER)

Ordinary india rubber is a very good insulating material, its very large elasticity gives to india rubber great mechanical advantages over other insulating materials It can be easily shaped to the form of the conductor on which it is employed, when used in the form of thin ribbons. In the open air it alters at 167° F. and starts fusing at 248° F. At 150 F° it hardens and gets to be fragile.

Owing to its large degree of inflammability a very careful supervision must be exerted in the manufacturing of cables insulated with india rubber, and to avoid scratches on the insulating covering, only first class and recently manufactured material must be used. It is used also for making insulating tubes.

Vulcanized India rubber is caoutchouc mixed with two per cent of sulphur. Its elasticity keeps up to 356° F. when it begins to fuse. It cannot be applied directly on copper wire as the sulphur it contains would combine with the copper. The wire must be tinned beforehand. It must contain less than five per cent resin and from 30 to 32 per cent pure Para to give good results. India rubber which has lost most of its insulating and mechanical properties can be regenerated by special processes and made to reacquire, at least in part, its good qualities.

EBONITE

This is nothing more than vulcanized india rubber in which the sulphur is brought up to 25 per cent or over instead of being kept down to two per cent. In cooling a dark mass is obtained. It is rigid and at the same time slightly flexible. Its dielectric power is very high unless some defect comes on the surface of the ebonite sheet—then it breaks down very easily. The same result obtains if oil or wax is put on the sheet.

It must not contain more than 30 per cent of sulphur and from 70 to 72 per cent of pure Para and its texture must be very homogeneous. It may be regenerated in the same manner as vulcanized rubber.

GUTTA PERCHA

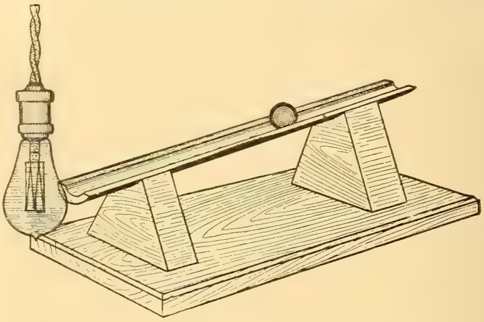
Gutta percha which is the milky juice exuding from some Chinese trees is the insulator par excellence. A gutta percha sheet 3-1000 inch in thickness breaks down only under a pressure of 15,000 volts. Its qualities depend upon the proportion of resins it contains and its insulating resistance varies with the temperature, the length of electrification and the pressure to which it is subjected. Its best property is of being impervious to the chemical action of water which makes it the material more adapted for submarine cable insulation.

SHELLAC

This is a kind of resin given out by branches of young trees under the secretions of some insects which are principally found in India. It is obtained commercially most generally in the form of rods or large flakes and is used when dissolved in alcohol. It is very easily affected by the humidity of the surrounding atmosphere and to avoid this it must be covered with paraffine. Practically all the different kinds of insulating cloths are made with shellac.

Jar Tests of Tungsten Lamps

If incandescent lamps are to be used where they will be subject to jarring, they should have the mechanical strength to withstand the jars even when the lamps are cold, otherwise the normal life of the filaments will never be reached. This is particularly true of tungsten lamps, which at first were rather frail, but which have been much improved as to the mechanical strength of their filaments during the last year or two. The processes of filament making and the methods of fastening the filaments vary with different manufacturers, making it difficult for the buyer to judge of the comparative qualities. To ascertain these in a practical way, the telegraph inspection bureau of the Swiss governmental railways has developed a testing apparatus which is at once simple and effective.



APPARATUS FOR JARRING TUNGSTEN LAMPS

It consists of a trough, graduated to show its length and inclined at a grade of ten per cent, with the lamp hung so as to rest against the lower end, and a rubber ball about an inch and a half in diameter, loaded with lead to make its weight a quarter of a pound. By starting the ball near the lamp and gradually increasing the distance through which it gathers momentum before striking the bulb, it is easy to tell how strong a blow it requires to snap a given filament. The first series of such comparative tests as recently made at Bern showed a wide variation in the mechanical strength of lamps of different makes.

How Tungsten Filaments are Squirted

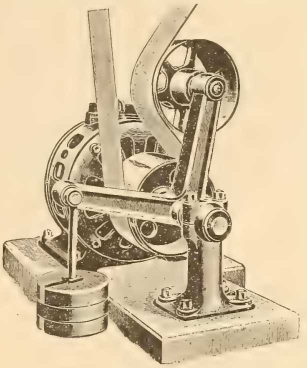
In the making of the filaments for tungsten lamps pure metallic tungsten is first secured by a long process of refining. This tungsten metal, which is then in a finely divided form, is mixed with a binding material to form a plastic mass which may be squirted in fine thread-like filaments. The process of making the filaments, as described by G. S. Merrill before the American Institute of Electrical Engineers, is an interesting one.

The paste, as it is called, is placed in a small steel cylinder and forced by a pressure of about 32,000 pounds per square inch through a small diamond die.

The die used in squirting tungsten filaments consists of a suitably mounted diamond of from one-half to one carat in weight through which a very minute hole has been drilled. In the smaller dies used today this hole is only about 0.0014 inch in diameter, which is smaller than an ordinary hair. The hole is drilled in the diamond with a steel needle, ground down so fine that it is as flexible as a hair and, as can be imagined, the drilling requires considerable time and patience. The stone when drilled is mounted in a steel casting in order to hold it against the enormous pressure used in squirting the filament.

Under such pressure the abrasion of the die even by the smooth tungsten paste is very rapid. This abrasion is a serious matter, as the diameter of the hole, and consequently that of the filament squirted, constantly increases. Moreover, the abrasion is not uniform, so that the hole enlarges more rapidly in the direction of one diameter than of the other, assuming when worn an elliptical shape. After enough filament for about 1,500 lamps has been squirted, it is necessary to have the die rebored, an operation which costs almost as much as the original die. A die cannot be rebored more than twice before it develops cracks or fissures which cause it to break. The next hardest material, sapphire, has been experimented with as a material for these dies, but it is found that such a die is very liable to split and that it will hardly make 100 lamps before it needs redrilling.

Belt-tightening Idler


BELT TIGHTENING IDLER

Sometimes the easiest way of adapting an electric motor to the driving of a given machine implies the use of a short belt, too short or too nearly vertical to allow the weight of the belt itself to give the needed pull on the pulleys. In such cases the adhesion of the belt to the pulleys may be increased by having an idler press sideways against the belt. This idler may even be carried by a weighted arm mounted on the shaft of the motor, making a compact outfit and one which adjusts itself to make up for the stretching of the belt.

Changing Dry Cells to Wet

The following method I have found useful in reviving old dry batteries: Take a clean glass jar and stand in it a worn-out dry battery. Around the battery place one-half pound of blue vitriol and then pour on water enough to come at least half way up the side of the dry battery. In an hour the cell will be ready for use again and will give service for some time.

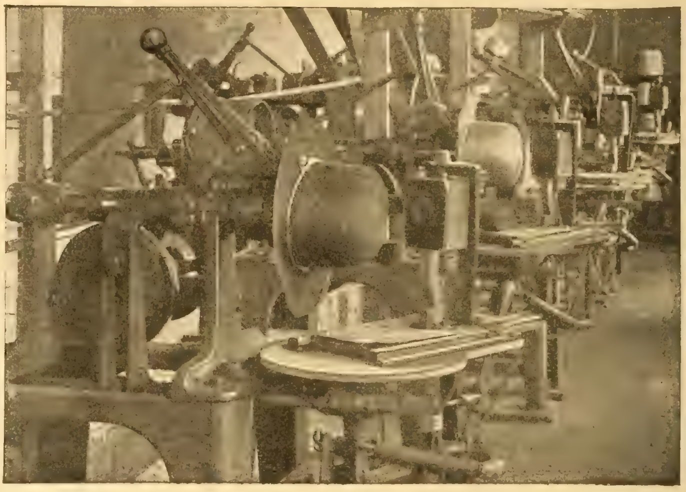
J. W. Stover.

ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

Electric Heat in Hat Manufacturing

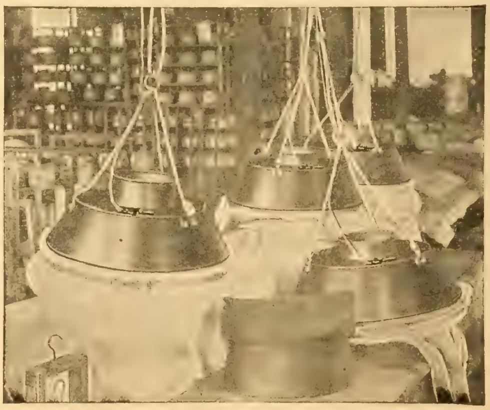
A hat is about the most simple thing imaginable—speaking now of a man's hat—yet few realize what an amount of complicated machinery and how many separate operations are required to make one. In the production of a finished hat from the raw materials power is required to operate the machinery, heat is required for sizing, coloring and drying, and heated tools are necessary for the finishing processes, so it is reasonable to suppose that electricity will be found right at home in a hat factory, and so it proves.



HAT IRONING MACHINES WITH ELECTRICALLY HEATED IRONS

A FEW DEFT PASSES OF THE "HAND SHELL" FLANGE AND CURL THE BRIM

For generations back the journeyman hatter has used what is called "hand shell" for ironing out the familiar soft felt hat. These hand shells or irons are of peculiar shape exactly fitted for the work in hand. He holds the hat, covered with a cloth, in his left hand and with a few deft



ELECTRICALLY HEATED FLANGING BAGS

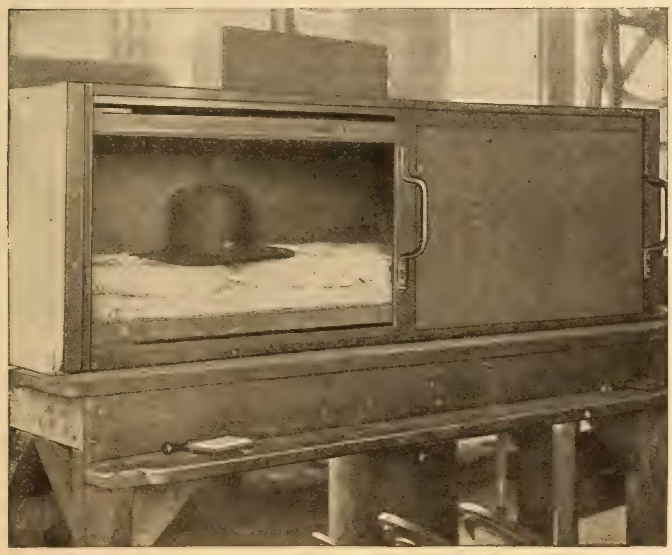
THE "LURING OFF" PROCESS, SHOWING THE ELECTRICAL VELOURING STOVE

passes of the iron smoothes it out, flanges it and curls the brim. In the modern factory this hand shell is heated by electricity in a manner similar to the ordinary electric flat iron.

But in some factories even this method is considered slow and electrically operated and electrically heated machines have displaced the "human element" in this phase of the work. In one of the illustrations a row of hat ironing machines is shown in operation. The heaters used with them, as well as with the other devices which will be described, are of the Westinghouse pattern. The hat is thrust onto a revolving chuck. Right in front of the nearest hat you will see a block-like object which is the electric heater. It is arranged so that it can be pressed against the crown or brim as the hat is revolved.

Before the hats are finally shipped they go through a last finishing process called "luring off," to make them smooth and glossy. The hat is placed on a "pouncing block" and the finisher uses a heated tool in each hand for smoothing out the fibers and making

"HAND FLATS" USED IN MAKING STRAW HATS



ELECTRICALLY HEATED OVEN

USING THE "SHACKLE IRON" TO CURVE THE BRIM

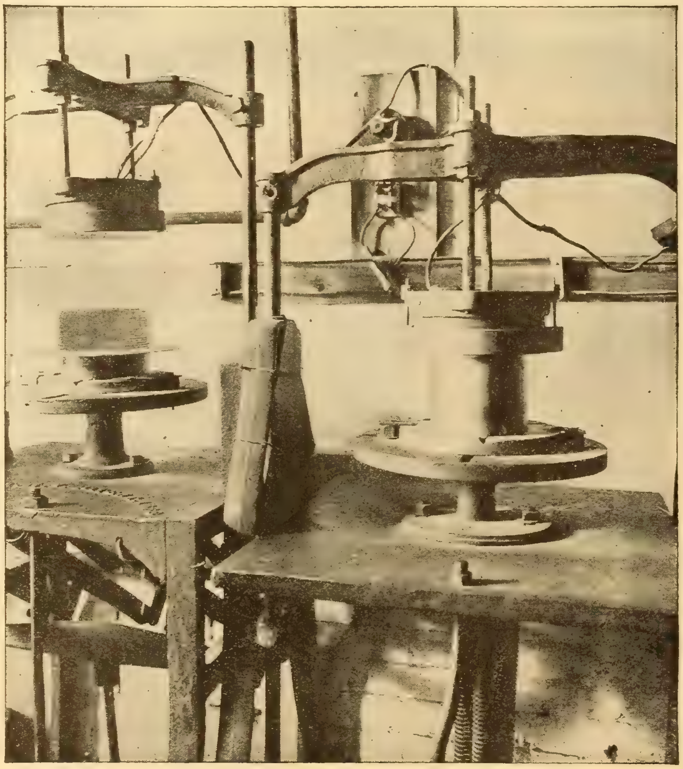
them lay all in the same direction and giving the "whirl" to the crown fibers. For supplying the heat necessary in this process what is known as an electrical "velouring stove" is used. It is made in the shape of a truncated pyramid with a smooth top on which the tools are heated.

The ordinary stiff hat or derby in the beginning does not appear much different from the soft felt. In this stage it goes through a baking process in an electrically heated oven to prepare it for the hydraulic press where it is formed. The baking ovens are of heavy sheet steel covered with a heat-insulating material.

After pressing into shape approximately correct the hats go from the hydraulic presses to what are known as flanging bags. These are mould-like arrangements containing hot sand, where the hat goes through another baking process and the brim at the same time is heated and pressed out flat by an electrical heater in the form of a flat plate. The sand also is brought to the high temperature necessary by electrical heating elements buried in it.

Now comes the curling of the brims, which is done by a "shackle iron." These are similar to the hand shells and are adapted to give a curl of from $\frac{1}{4}$ inch to one inch.

In the making of straw hats electrically heated tools are also widely employed. Principal among these is the "hand flat,"



STRAW HATS IN THE PRESSING MACHINES

a device with two handles like a rolling pin. In the production of high grade straw hats absolute cleanliness is necessary in this process in order to turn out a spotless product. This is almost impossible in a room where the air is charged with fine flecks of soot from gas-heated irons, so here electrically heated "flats" have a marked advantage. When not in use the tools are laid on pedestal-like stands as shown in the illustration.

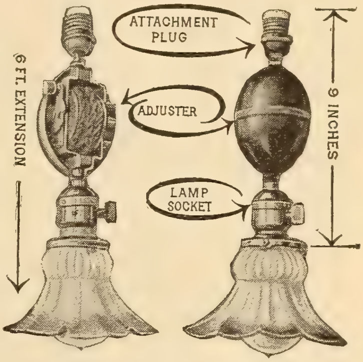
In forming the straw hats they are pressed into shape by dies which operate under great pressure. These dies must be heated at the same time and the heating is accomplished by imbedding an electrical heating element in the die itself.

Besides the machines above enumerated the hat factory of today is also equipped with electrically heated glue pots, electrically heated irons for cementing the tips to the light linings and for embossing and printing hat bands and labels, leather shapers and various other devices.

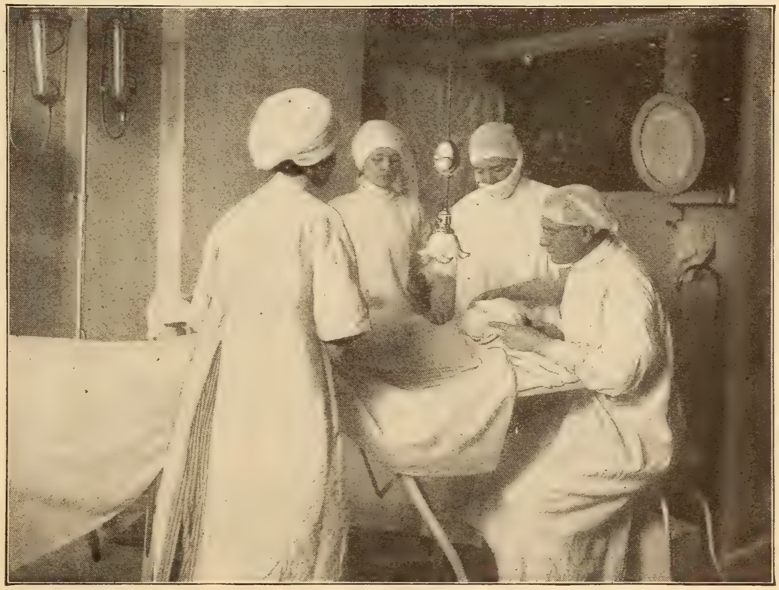
Adjuster for Lamp Cords

Eyesight is too great a blessing to be trifled with, but the majority of us go on day after day apparently trying to see just how much our eyes will stand. A strong light shining directly into the eyes weakens them. Light that is too weak is just as bad.

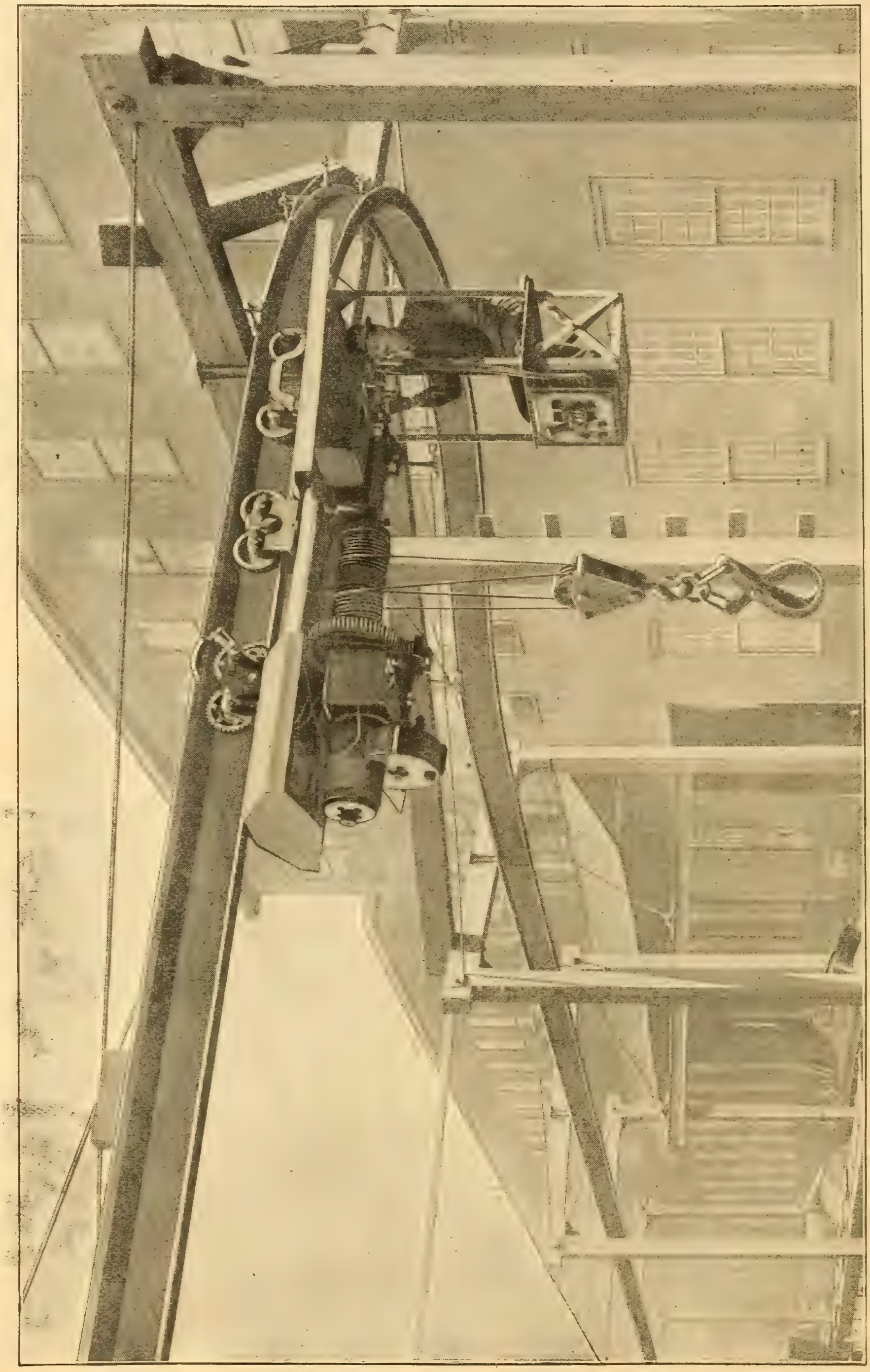
The ordinary electric drop light offers no means of adjustment except perhaps by a cumbersome loop arrangement passing through two holes in a wooden ball. You tug and strain on your tip toes to do something with it and then give up in disgust. In the new Hagstrom electric cord adjuster a remedy has, however, been supplied and the lamp can be raised or lowered more easily than a window shade. Or the cord may be extended to great length and the lamp carried to any part of the room to be returned again to its original length by pushing a button on the adjuster. That is, to lengthen the cord you pull upon it and to shorten it you push the button. The detail picture shows more plainly than words how the device operates. The picture in the operating room of a hospital indicates one application of the adjuster.



LAMP CORD ADJUSTER



PREPARING FOR A SURGICAL OPERATION—ADJUSTER PLACES THE LAMP WHERE NEEDED



A TRAVELING ELECTRIC HOIST

Electric Traveling Hoists

The time is past when manual labor by sheer muscle must lift, pile, load or unload iron, lumber or other heavy stock in a big industrial plant. Traveling electric hoists do this work at small cost as compared to the wages of a laborer and more quickly and satisfactorily. Every business has its own special requirements and builders of electric traveling hoists are ready to go on the ground and build machines adapted to almost any purpose. The illustration opposite shows a Pawling and Harnischfeger traveling hoist for service about the yard of a manufacturing plant. The heavy I-beam track from which the two-motor hoist is suspended allows heavy loads to be lifted and carried from one end of the yard to the other.

Magnets Instead of Tongs

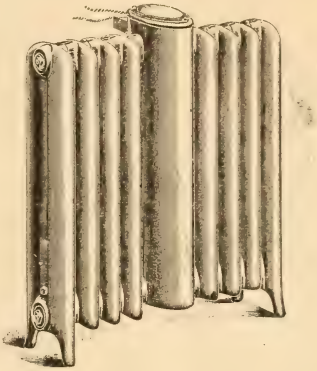
The ordinary blacksmith's tongs of our forefathers' time are still generally used for tightly gripping steel or iron while the same is being shaped on an anvil. But when it comes to taking pieces out of the fire and dipping them into oil or water to harden them, these same tongs are wasteful of time, particularly if the pieces are small or round in section.

A MAGNET USED INSTEAD OF TONGS

Where such hardening or tempering is done in quantities, much time is saved by using a long handled electromagnet to which the piece of steel will cling even while hot and by means of which it can be plunged into the hardening bath in less time than it often would take to grip it with tongs. To release the lifted piece, a push button on the farther side of the handle shuts off the current, which is the same as for a six-candle-power lamp. Of course the device is both water-proof and fire-proof. For tempering purposes it is usually fitted with a 20-inch stem, thus allowing the operator to reach well into the furnace without burning his hands.

Electrically Heated Hot Water Radiator

No serious thinker can use a hot water bag to warm his feet on a cold winter night without being impressed with the capacity of water for holding heat. This unusual facility for storing heat is due to the fact that it takes a comparatively large amount of heat for every degree that the water is warmed. Pound for pound, water will require about eight times as much heat to warm it a given number of degrees as iron, five times as much as stone and about thirty times as much as lead, gold or mercury. Therefore, when any quantity of water has been warmed, it has a large amount of heat stored up in it which it can radiate slowly after the supply of heat is removed.

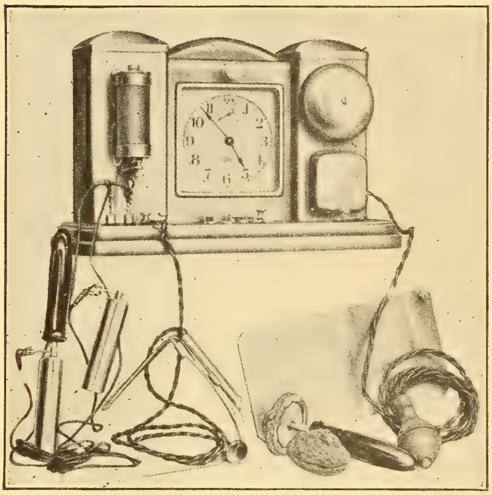

ELECTRICALLY HEATED RADIATOR

This accounts for the satisfaction given by hot water radiators, to which the hot water is generally supplied from a boiler or a furnace coil. Owing to the needed piping, such radiators are necessarily fixed in position and suitable for use only where a boiler or furnace is close at hand. If we omit the piping and heat the water in the radiator electrically, the radiator can be placed anywhere and moved at will, as long as it is connected to the current by flexible cords. Moreover, each radiator can be controlled entirely independent of all others, which is hard to do with many hot water systems.

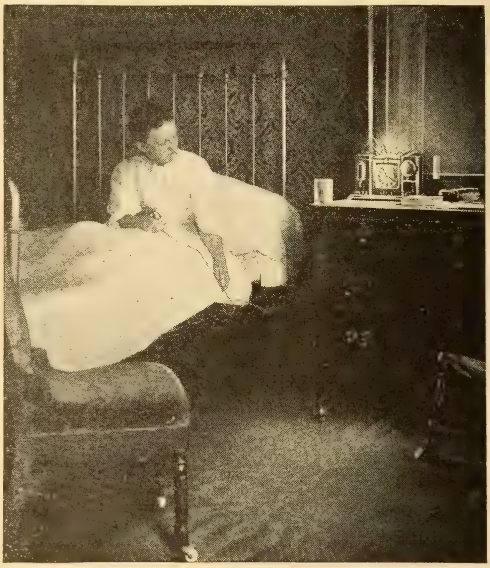
The British type which we picture is one of five sizes, holding from 4½ to 10½ gallons, of which the smallest takes a maximum of 800 and the largest 2,400 watts at the start. This consumption of current gradually decreases, as the water warms, so that the maximum after an hour's use is only three quarters of what it was at first.

The Electric Utility Clock

The tendency nowadays is to make electricity our servant in every way possible, even going so far as to make it our personal attendant, so to speak. It is a very common thing to find in homes an electric alarm clock, electrically lighted clocks, medical batteries and coils, flashlights, etc. Going one step farther, it has been the aim of the Darche Manufacturing Company to combine as many of these little aids and conveniences as possible into one compact set. How well they have succeeded will be seen from the following description of the utility clock and medical battery outfit.



ELECTRIC UTILITY CLOCK



TO ASCERTAIN THE TIME, SIMPLY PUSH THE BUTTON

In the first place there is embodied in the outfit a reliable and at the same time artistic timepiece. Right above it is an electric lamp. A cord and handle, with push button, makes it possible to flash the lamp from any part of a room. Hang the cord and push button over the head of the bed and you can very conveniently ascertain the time at night, or if you are one of the kind that "hear things at night," you may very easily satisfy your curiosity in the same manner.

THE LAMP IS LIGHTED AUTOMATICALLY WHEN IT IS TIME TO GIVE MEDICINE

At the right of the clock is an electric alarm which can be set to go off at any predetermined time. At the same instant the lamp lights—all automatically. If the clock is being used in a sick room and a "silent" alarm is desired the bell circuit may be switched off and the light, only, arranged to appear at the given moment, as, for in-

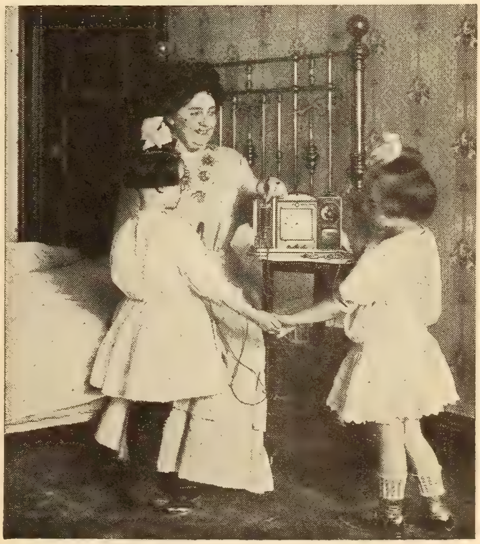
EASY TO EXAMINE A CHILD'S THROAT

stance, to notify the nurse when medicine is to be given. The batteries which accomplish all this are concealed in the cases on each side the clock case.

The medical attachment is operated by simply placing the controlling switch on a special contact point which immediately directs the current from the batteries into the medical induction coil seen at the left of the clock. From this coil the ordinary faradic current is obtained through cords and hand electrodes. The strength of this current may be regulated by raising or lowering a hollow metal core within the coil.

Another useful feature is the surgical and dental attachment. You feel perhaps that there is something the matter with one of your teeth, but you wish to examine it yourself before going to the dentist. In that case it is customary to take a small pocket mirror, put it in your mouth, stand up before a large mirror and crane your neck trying to look inside your own head. With this outfit, however, goes a little attachment which makes the operation a simple matter. It consists of a tiny incandescent lamp such as dentists use, mounted in the end of a thin tube which may be readily placed in the mouth or throat. With it goes an instrument for holding down the tongue, also a little dental mirror. With these instruments it is possible to examine your own teeth or throat, or examine a child's throat and even the in-

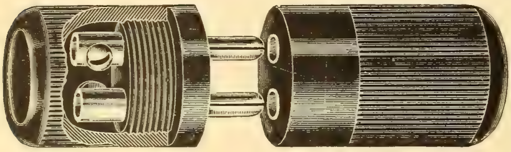
YOU BECOME YOUR OWN DENTAL EXAMINER



A STIMULATING CURRENT FROM THE MEDICAL INDUCTION COIL side of the nose and ear. The apparatus complete is ready for use at any time without making special connections, and ordinary dry batteries are used which are readily replaced at any time.

Midget Separable Connectors

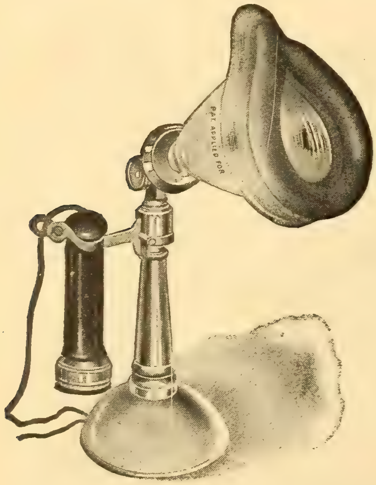
Here is a connector that will appeal to every automobile user who lights with electricity. The connector is made of hard rubber so that the user is protected from shock and when in service has no exposed metal parts. The cord is attached within the connector as shown. The device is very handy for connecting battery lamps to the circuit and in other places where a quick connector is desired.



MIDGET SEPARABLE CONNECTOR

Telephone Attachment for Noisy Places

Your office is located perhaps at a noisy street corner so that to make the listener to whom you are talking understand you must talk very loud. There are times also when you desire to talk on private matters within the hearing of others without embarrassment. You may prevent these annoyances by the use of the Rochester telephone muffler, much less expensive than a booth and always within reach on your desk.

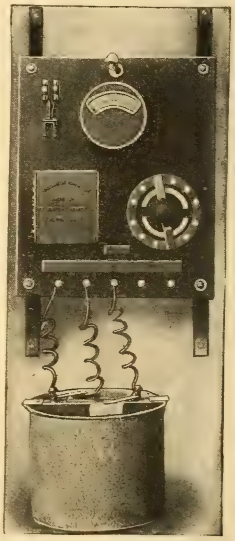


AS GOOD AS A TELEPHONE BOOTH

The device is made of glass with a detachable rubber mask as illustrated and can be readily attached to any telephone.

Rectifier for Obtaining Direct Current

When direct current is not available some rectifying means is necessary to change the ordinary alternating lighting current in order to charge storage batteries. The Economy rectifier presents one way of doing the trick. The set consists of a small transformer to reduce the voltage of the alternating current somewhat; an electrolytic rectifier, sometimes known as an "electric check valve," into which the transformer feeds the current and from which the current comes out as direct current, that is, flowing continuously in the same direction; and finally a little switchboard with the necessary switches and an ammeter for measuring the current.



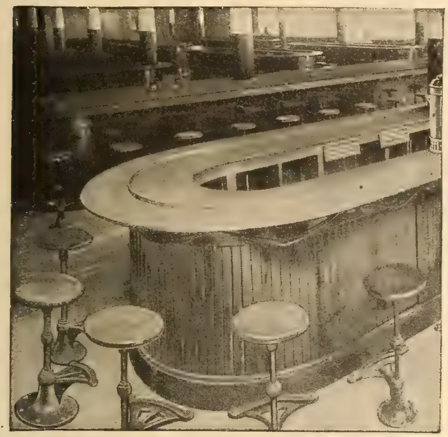
ALTERNATING CURRENT RECTIFIER

The electric rectifier is the most distinctively new element in the whole set. It consists of a large agate-ware pail, with three electrodes, one of lead and two of aluminum, immersed in an electrolyte solution, and mounted upon a strip of slate with binding posts attached.

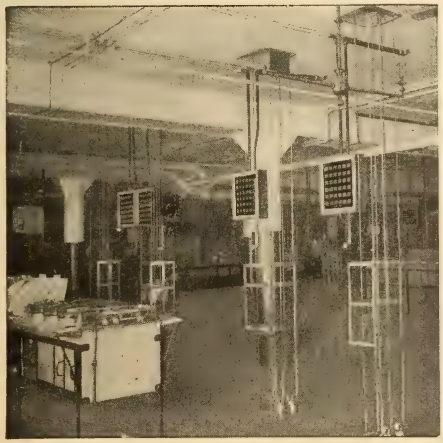
The current supplied from the transformer flows through the solution from the lead plate alternately to either aluminum. Owing to a remarkable electrochemical property of aluminum, it cannot flow in the opposite direction. Hence the alternating current is changed to a one-direction pulsating current, perfectly adapted for charging storage batteries.

Serving a Quick Lunch Quicker

In some of the quick lunch establishments of the larger cities the number of patrons served between the hours of 12 and 2 o'clock may pass the thousand mark. Each bill is small, and so it is only by providing for a very large number that the establishment is able to pay the enormous rent of a good location in the down-town district and make a profit besides. Therefore every little refinement in operation is employed to save a minute or a few seconds, even, in serving a patron.



LUNCH COUNTER WITH BUTTON PLATES



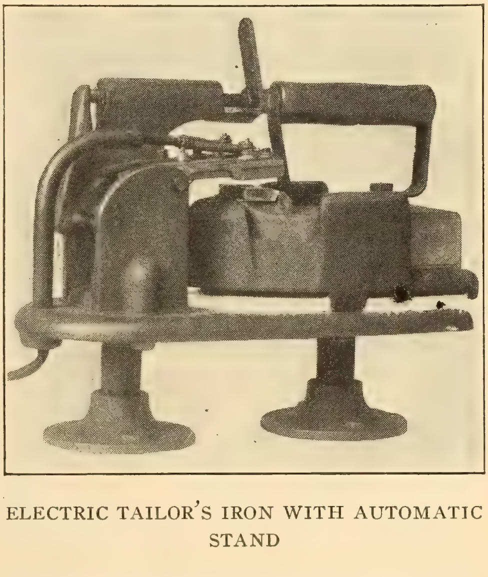
SERVING ROOM ANNUNCIATORS

The latest aid to such restaurants is the Holtzer-Cabot electric restaurant call system which furnishes a means of instant and silent communication between lunch counter and serving room, by means of which the waitress at the counter can communicate the most frequent and simple orders to the serving room.

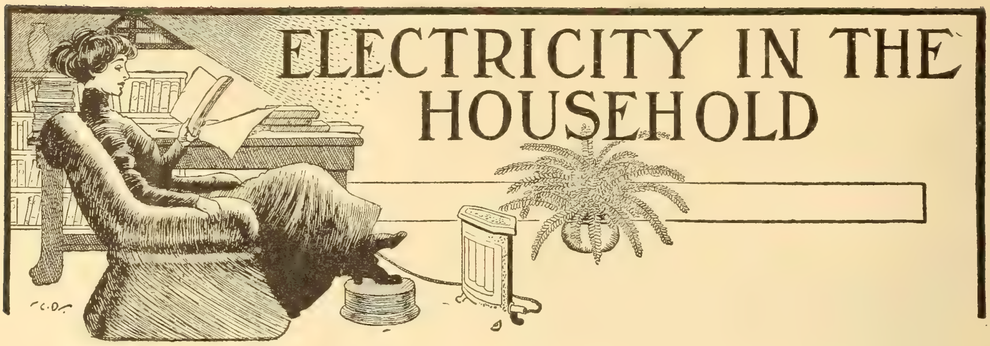
At the counter are arranged a number of panels of push buttons placed as shown in one of the pictures. Suppose the order is "coffee and sinkers." The waitress pushes the proper button and instantly an annunciator drop on a panel in the serving room falls and exposes a number which means to the chef at the serving table "coffee and sinkers." He then fills the order and everything is ready for the waitress as soon as she arrives at the serving room.

Pressing Iron of New Design

The tailor's electric iron here shown is somewhat unusual in design in having the flexible cord attached to the stand rather than to the iron. The general construction is similar to that of irons with the cord attached except that the terminals of the heating element within the iron are brought out at the toe, so that by operating the lever at the top, the iron, when placed on the stand, may be connected to the flexible cord circuit or not as desired. By the use of this type of stand and iron the Westinghouse company seeks to obtain a better use of the flexible cord and provide for greater convenience.



ELECTRIC TAILOR'S IRON WITH AUTOMATIC STAND



ELECTRICITY IN THE HOUSEHOLD

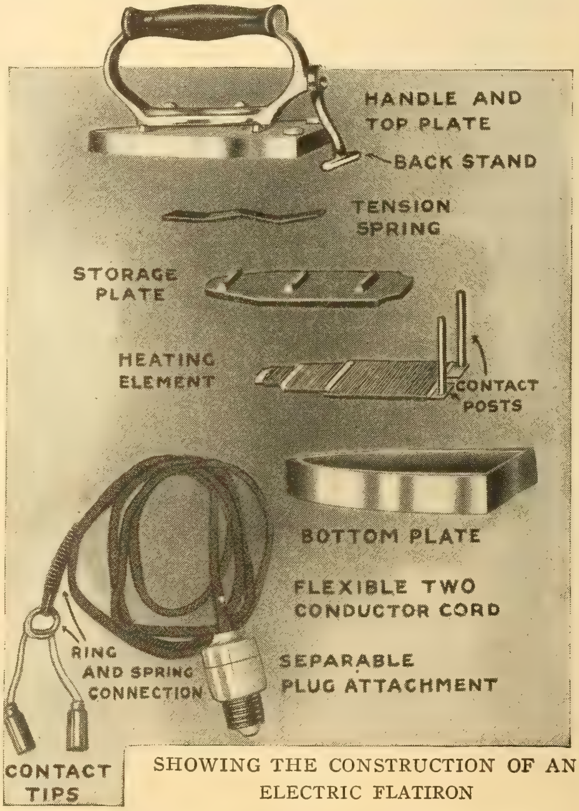
How Electricity is Turned to Heat

Heat—where you want it, when you want it and at any degree you want it; without waste, without smoke and soot and without consumption of oxygen. These are the overwhelming advantages that have made electricity the factor which it is today in domestic science and which in a few short years will make it the essential agent, not an adjunct, in the conduct of every well regulated household.

From month to month there have been described in this department a great many types and makes of electrically heated utensils to lighten the tasks of housekeeping —it seemed that we had described them all. But an entirely new set of brains has been at work on the problems of electric heat and an entirely new set of electrical household utensils has been developed as a consequence. They were all designed, built, experimented with and tested in every conceivable way before being placed before the public.

Up in Milwaukee, Wis., there is a firm by the name of Cutler-Hammer. The name is known to every electrical engineer, but for a product which is so removed from household affairs that it is very seldom heard in the home. But this firm has seen the great possibilities in the new field of electric heating and cooking and has set out quietly to see what it can do in the way of making a name in this line. The devices here described bear the name of Cutler-Hammer and employ electric heat for purposes outside of cooking. A complete line of electric cooking utensils is to be exploited later, and will be described in this department in a future issue.

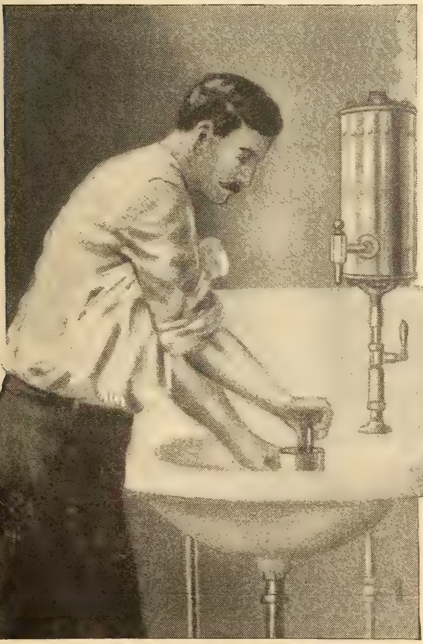
First, of course, comes the electric iron and for the sake of those who have often wished to know what is inside of such an iron, a picture is shown of one of them taken



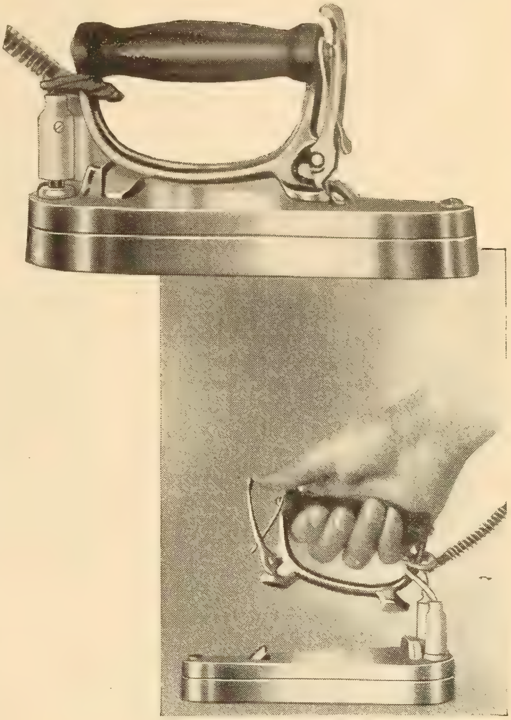
SHOWING THE CONSTRUCTION OF AN ELECTRIC FLATIRON apart. The most important feature of all, in any type of iron, is the heating element shown in the middle of the picture. The electric current comes in at one of the upright contact posts, flows around the flat coil of wire and out at the other post. In its passage through the fine wire the latter is heated, which heat is conveyed to the bottom plate and also to the storage plate. In this iron the arrangement of the heating element is such that all parts of the face of the iron—point, heel and edges—are equally heated, while the storage plate "soaks" up the excess heat like a sponge, to be given to the iron after current has been shut off.

A rest is provided which consists of a back stand—a T-shaped bar attached to the heel of the iron. When not in use the iron is turned up on end, the back stand or T-bar holding it clear of the ironing board. This renders unnecessary the use of a metal stand, which tends to draw the heat out of an iron. The back stand may also be adjusted to support the iron face upwards, and in this position the iron may be used as an electric stove for heating water, milk, etc.

The "ring and spring" connection is another feature to merit attention. All users of electric irons know that the wear on the cord is greatest at the point where the cord is attached to the iron. Kinking and chafing at this point soon wears out the stoutest cord. The ring and spring connection prevents this, forming a flexible (instead of a rigid) connection, thus allowing the iron to be turned in any direction without wear on the cord.



ELECTRIC LAVATORY HEATER



FOR IRONING SLEEVES

The iron which is shown complete in the illustration above is for ironing sleeves. It has a long narrow body and weighs only four pounds. The handle is detachable, making it convenient for traveling.

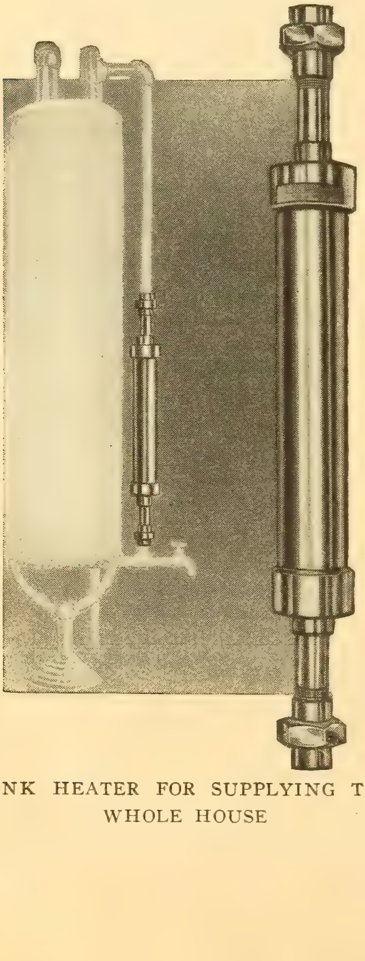
Probably the most novel feature of this new line of heating apparatus is embodied in the water heaters. You will be surprised, when you see absolutely cold water turned to hot and from that to steam in a minute's time, to find out that the water itself forms the resistance to the electric current and develops within itself the heat which performs the seeming miracle. In ordinary electric water heaters there are coils of resistance wires which are heated by the passage of the current exactly in the same manner as in the electric flatiron. In these new heaters, however, what are known as carbon electrodes are used.

There are two sets of these electrodes in each heater, placed at a little distance apart.

One set of electrodes is connected to one terminal of the electric circuit and the other set to the other—this being accomplished by the ordinary cord and plug. Now you might turn on the switch and no harm would be done to the heater because no current is flowing through it. Suppose, however, you let water into the heater—cold water right out of the piping system. The water surrounds the two sets of electrodes and water being a slight conductor of electricity, current begins to flow through the water from one electrode to the other. The resistance is so great however, that heat is generated, which warms the water.

By letting the water run quite fast through the heater you get a continuous supply of hot water—even boiling. Shut off the water so only a little goes through and you get steam for sterilizing purposes, etc. Now shut off the water altogether and go away and forget to shut off the current. The little water that remains will be turned into steam and escape. Then the heater is dead because current cannot flow through it when it contains no water. There can be no explosion through forgetfulness, because there is always an outlet for the steam to escape. There can be no burned out heater because there is nothing to burn out and besides, the current is automatically shut off when the water is gone.

BATH HEATER



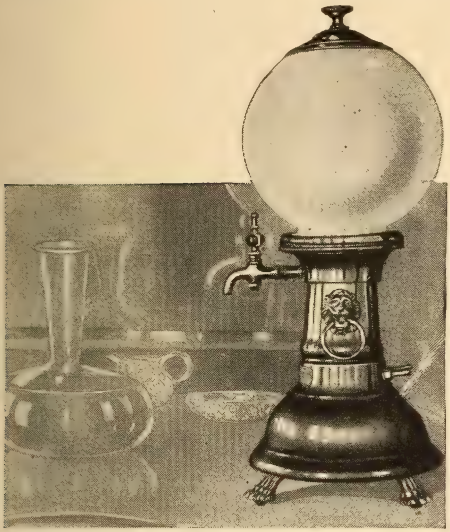
TANK HEATER FOR SUPPLYING THE WHOLE HOUSE

In houses possessing no hot water system, the lavatory heater will furnish a copious supply of hot water at any hour of the day or night. In houses in which furnace heat is used to supply hot water this heater will be found a great convenience in the summer months when there is no furnace fire and consequently no hot water supply.

The lavatory heater is provided with a regulating device which enables the temperature of the water to be varied from luke warm to scalding hot.

The bath heater is similar to the lavatory heater, but is of much larger size. It is furnished mounted on a marble panel measuring thirteen and one-half by eighteen inches, this panel carrying a main line knife switch to turn on the current and a little "pilot" lamp to show at a glance when the current is on and the heater in operation. A regulating device, similar to that of the lavatory heater, is provided whereby the heat of the water flowing from the bath heater can be varied through a wide range of temperatures.

The tank heater is an electrical device for heating the contents of hot water tanks. It consists of a metal cylinder somewhat more than two feet in length by three inches in diameter. It is easily installed, is of sufficient capacity to furnish a plentiful supply of hot water for household use and is free from the objectionable odors and dangerous eminations sometimes generated by gas heaters.



PORTABLE WATER HEATER

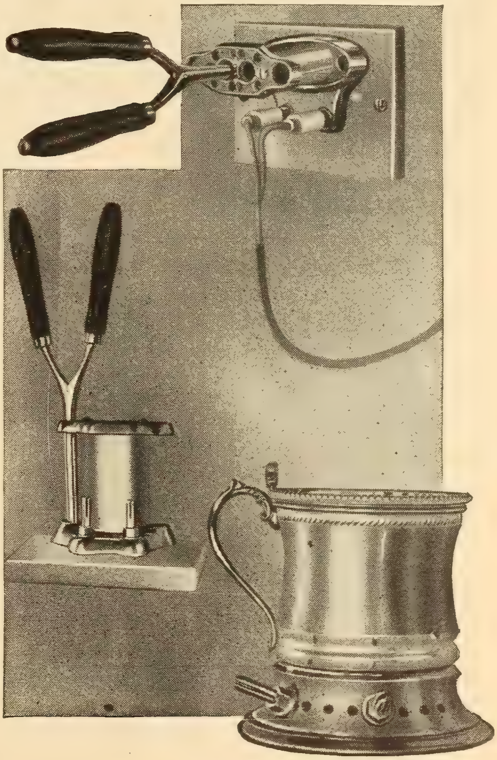
The three types just described are all of the carbon type. There is besides a portable heater built upon a somewhat different principle; that is, the heating element is composed of wire and is contained in the base of the heater. The arrangement is such that the cold water must pass down through a tube, which is surrounded by the heating coil and then upward again into the glass jar, from which it is drawn through a faucet. The instantaneous heater for household use will hold three quarts. Starting cold, the first glassful of steaming hot water can be drawn in 45 seconds after the current is turned on. A second glassful can be drawn fifteen seconds later and so on until the globe is emptied.

Then, too, there are some electrically heated toilet devices. For instance, the curling iron heater, consisting of a metal casting mounted on a marble or slate base, may be used either on the dressing table or may be fastened by two screws to the wall, holes being drilled in the base for this purpose.

The metal casting is nickel plated and has a top plate provided with four openings, the two outer ones being designed to hold the curling iron when not in use. The two inner openings (both of which may be used should it be necessary to heat two irons at one time) lead to the heating chamber in which is an automatic switch which admits current to the heating element as soon as the iron is thrust into either of the openings. On withdrawing the iron this switch automatically cuts off the current until the curling iron is again inserted in the heater.

When used on a dressing table note that the thrust of the iron is downward, not sidewise, this making it unnecessary to hold the heater with one hand while the iron is inserted or removed with the other.

The electric shaving mug stands five inches high and is nickel plated inside and



CURLING IRON HEATER AND SHAVING MUG

out. The heating element is contained in the bottom of the mug. Above this is a water chamber holding about one-half pint, and inserted in the top of the mug is a removable soap tray.

During the chilly days of late fall or early spring, before the furnace fire is started, or after it has been permitted to go out, the portable electric radiator will prove a real comfort.

Nearly every household has at least one room that is "hard to heat" and is therefore often unoccupied even when the furnace is in operation. The electric radiator makes such rooms habitable.

COMFORT BY THE ELECTRIC RADIATOR

The radiator illustrated, which is made in three sizes, has three switches, in the case of the largest size and gives three degrees of heat. These radiators may be used in any room in the house by providing suitable connections to the electric mains. There are no odors, no open flame, no muss, as in the case of oil and gas heaters,—nothing but "clean heat" and plenty of it.

One Electric Stove Cooks for Eighteen

Is it possible to provide economically for a large family by making use of an electric cook stove alone? Some scout the idea, but the following test which was made recently in the Electric Shop, Chicago, is convincing.

A party of guests, eighteen in number, was to be served with a full dinner prepared on a single electric stove, and the Hughes type of stove was selected upon which to do the cooking.

The dinner served consisted of consomme, roast beef, lima beans, potatoes, a salad, peach shortcake and coffee. The meal was cooked in two hours' time at a current consumption of 2074 watt hours, which shows a current consumption per person of 115 watts. Figuring this on a basis of ten cents per kilowatt hour shows that the current cost of feeding each person was one and fifteen-hundredths cents. The current consumption in cooking the consomme was 176 watt hours; the roast, 1,318 watt hours; lima beans, 219 watt hours; shortcake, 146 watt hours, and the coffee 255 watt hours.

In the preparation the consomme, of which there was two quarts, the 880 watt burner was brought into use and was run at full heat for five minutes, after which time the current was turned off, and the storage heat in the burner finished it. The roast was cooked in the oven, which has a total capacity of 1,760 watts. The oven was turned on for ten minutes before the roast was put in; after the roast was in ten minutes the current was turned down to the next to low heat, or medium heat, which consumes 440 watts; this was left on for one hour and forty minutes, at the end of which time the roast was taken out.

Immediately upon removing the roast from the oven, the pastry of the shortcake was put in, the oven being turned to high heat for five minutes, after which the oven was turned off and the cake left in for three minutes, in which time it was cooked perfectly.

The potatoes, of which there were half a peck, were put on the 880-watt burner, and run for fifteen minutes, after which it was turned to the 220 and run for 30 minutes, giving a current consumption of 293 watt hours. The coffee was the only thing not made on the stove. It was made in individual electric coffee percolators of 500 watts each, which were run for ten minutes, showing a total current consumption of 250 watt hours.

The range was primarily designed for taking care of the requirements of a family of not to exceed eight people, but the above shows what can be done when it becomes necessary to use the range for a more elaborate dinner.

A Little Motor for the Home

A small electric motor which may be put to several uses with very little bother is an exceedingly welcome addition to the household equipment. It is hard to appreciate, except by actual experience, how much a little electric current rightly applied can do to help out with the work.

The Westinghouse general utility motor here illustrated is provided with a number of easily changeable attachments adapting it to various purposes about the house. A handle is arranged on top for convenience in lifting the device about. The motor can be attached to the sewing machine by detaching the base and setting on the machine in a base containing a pedal attachment for starting and stopping.

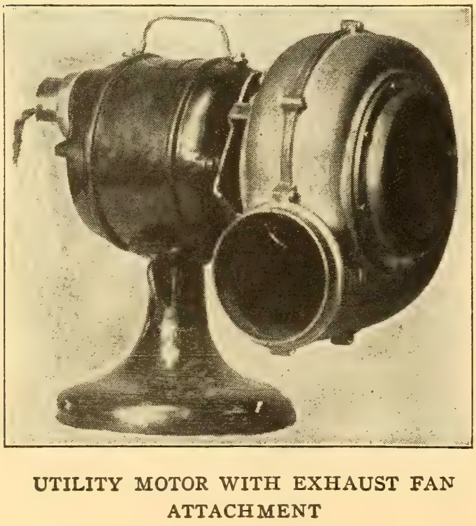
A small blower attachment for supplying air to the kitchen, reviving the furnace fire, or ventilating a sick room is provided. It is surprising how quickly a blower of this type will change the air in a room when properly

UTILITY MOTOR FOR GRINDING CUTLERY AND POLISHING TABLE WARE

UTILITY MOTOR ATTACHED TO SEWING MACHINE

placed so as to blow the impure air out of a window or door.

Two other attachments for the motor which are of great assistance in the kitchen are a buffer and grinder which may be attached to the shaft in a moment.



UTILITY MOTOR WITH EXHAUST FAN ATTACHMENT

Flatirons as Sterilizers

In Bohemia it has recently been demonstrated that ironing has a sterilizing effect.

The proof came about in this way: Being eager to avoid carrying any infection from homes in which his graduates were treating contagious diseases, Prof. K. Svehla of the Czech University at Prague insisted that the doctors should wear special linen cloaks These were to be left at the house of the patient to be sterilized. But Prof. Svehla found that the average Prague household did not offer proper facilities for this sterilizing. He therefore experimented as to the simplest method of accomplishing this and found that the ordinary process of ironing a moistened material serves to sterilize it. With thin fabrics like handkerchiefs, which had been purposely loaded with micro-organisms, a single ironing proved sufficient.

A happy young couple in Nome
From cafe to cafe did roam
When she told him he oughter
A toast stove he bought 'er
And now they have breakfast at home.

Mrs. Murphy up north in Racine
On wash day was a sight to be seen
When her back nearly broke
She made a bold stroke
And bought an electric machine.

And there was sweet Kitty LaPearl
Whose hair wouldn't stay in a curl
But after some thought
A curler she bought
And now she is a contented young girl.

Last summer Miss Maggie Odell
In her white dress appeared very swell
An electric iron was the reason
She made the hit of the season
While her friends worked around hot as
blazes.

An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART XI.—CONSTRUCTION OF A SMALL MOTOR

The following description is of a motor that has been constructed and found to give very good results. The field and armature of this machine are made from sheets of soft iron cut to certain dimensions and then assembled, instead of making them from cast iron. Cut from some sheet iron such as is used in making stove pipe, or you can use old tin cans, as they are nothing more than sheet iron with a thin coat of tin over it, a number of pieces whose dimensions correspond to those given in Fig. 102. You should have enough of these pieces to make a pile two inches high when they are placed on top of each other and firmly clamped. Drill six 1-8-inch holes in each of these pieces as shown at (H1), (H2), (H3), (H4), (H5), and (H6). These holes are to be used in clamping the various pieces of iron together as follows: Cut from some heavy sheet iron two pieces whose dimensions are identical to those given in Fig. 102 with the exception that they are $\frac{5}{8}$ inch longer than the other iron pieces as shown by the dotted lines. These pieces should each have holes drilled in them to correspond to those drilled in the thinner pieces, and in addition two $\frac{1}{8}$-inch holes (H7) and (H8) to be used in mounting the motor. Now bend the lower ends (E1) and (E2) over at right angles and you are ready to assemble the frame. Obtain six $\frac{1}{8}$-inch bolts, four $2\frac{1}{4}$ inches long and two $2\frac{1}{2}$ inches long. Put the four shorter bolts through the holes (H3), (H4), (H5), and (H6), in one of the thick pieces of iron with the heads on the same side as the projections (E1) and (E2). Lay this piece on a board with the heads on the underside and place the thin sheets of iron over the bolts, one at a time. Examine each of these pieces to see that its dimensions correspond to the one just below it. You will find the work in cutting these pieces out greatly simplified if you first cut out one of the heavy pieces and use it as a pattern in cutting the remaining ones. This suggestion should be used in drilling the holes, if not in cutting out the pieces, as these holes must all be in line when the pieces are in a pile. When all of the thin sheets are in place the remaining heavy one can be put

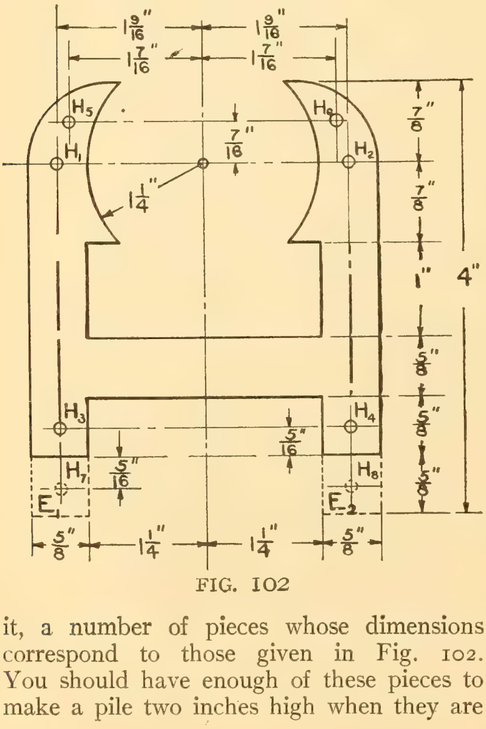


FIG. 102

on and the bolts drawn up. You may have to use a vice or clamp of some kind in forcing the last few pieces down on the bolts, due to their spring, unless they are perfectly flat.

The armature of the motor is to be built up in the same say. Cut from some thin iron the same number of pieces you cut for the field, whose dimensions correspond to those given in Fig. 103. Drill a ¼-inch hole in the center of each of these pieces and three 3-64-inch holes (H1), (H2), and (H3), one in each projecting arm. Cut two pieces from heavy iron to the same dimensions and file a small groove in one side of the hole in the center of them as shown by the dotted lines. These pieces should now all be fastened together by means of three rivets passing through the holes in the projecting arms.

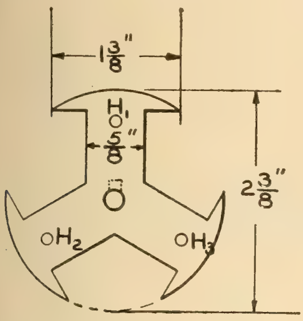


FIG. 103

The shaft that is to support this armature should be made from some ¼-inch iron rod, or brass will do, but it is not so good as the iron. Take a piece 4½ inches long and turn down each end to a diameter of ⅛ inch, as shown in Fig. 104. Now thread the ends of the larger part of the shaft, to take a small ⅛-inch nut, to a distance of 1⅛ inches on one end and ⅝ inch on the other end. Slip the armature core on the shaft and mark the shaft where the grooves in the end pieces of the core come and then drill two ⅛-inch holes about half way through the shaft. Place a small pin in one of these holes, then put the core in place and the second pin can then be put in its hole. The nuts on the end of the shaft should now be drawn up and the core will be held rigidly to the shaft. The core should be 1¾ inches from one end of the shaft and ¾ inch from the other end.

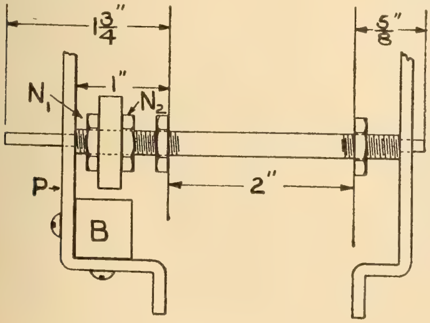


FIG. 104

The bearings for this shaft and armature are shown in Fig. 105. Cut from some ⅛-inch sheet brass two pieces about six inches long and bend them into the forms shown at (A) and (B). Drill six ⅛-inch holes in these pieces as shown at (H1), (H2), (H3), (H4), (H5), and (H6). The two holes (H3) and (H4) are to carry the armature shaft, while the remaining ones are to be used in mounting the pieces on the frame of the machine shown in Fig. 102. The two long ⅛-inch brass bolts can be used in holding these pieces in place with the bolts through the holes (H1) and (H2).

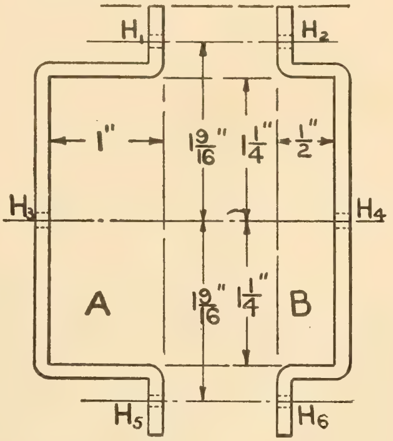


FIG. 105

Before the last support is put in place put the armature in position and then fasten the supports rigidly. The armature should revolve clear of the frame provided the construction of the various parts has been properly taken care of.

Assuming the armature and field work as they should you can now take up the construction of the brushes and commutator. Turn from a piece of ¼-inch hardwood a piece one inch in diameter. Now cut from some 1-16-inch brass a piece whose dimensions correspond to those given in Fig. 106. This piece can now be bent around the edge of the wooden disk and the projecting arms (A1), (A2), etc., bent down along the side and fastened to the disk with small screws or brads through the holes in them. The arms (C1), (C2), and (C3) should not be bent down, as they are to be used in connecting the armature winding to the commutator. After the brass has been fastened in place saw it into three equal pieces. The space separating the pieces should be about 1-16 inch. Drill a ¼-inch hole in the center of the disk and slip it in place on the shaft as shown in Fig. 104, fastening it with two lock nuts.

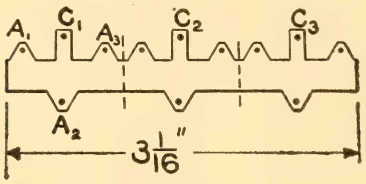


FIG. 106

The brushes should be mounted on a wooden block ⅝ inch square and 1⅛ inches long. This block should be fastened in the corner of the support (P), Fig. 104, with two brass screws that pass through the support and into the block. Cut from some 1-16-inch spring brass two pieces whose dimensions correspond to those given at (A), Fig. 107, and bend them into the form shown at (B). These two pieces should now be mounted on the opposite ends of the wooden block with binding posts that have a small wooden screw in them.

The motor is now complete with the exception of the winding. Wind on each leg of the armature in regular order about 80 turns of No. 20 double cotton covered copper wire. These legs should all be wound in the same direction and the inside end of one winding connected to the outside end of the next. This connection can be made at the commutator segments. Insulate the core well with some paper before you attempt to wind it. The field should be wound with about ½ pound of No. 18 B. and S. gauge, double cotton-covered, copper wire. Insulate the core well before winding and cover the completed winding with tape. One end of this winding should be connected to the lower brush and the other end to a binding post mounted on the wooden base for your motor. A second binding post on the base should be connected to the upper brush.

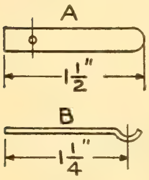


FIG. 107

A small metal or wooden pulley can be made and fastened to the projecting end of the shaft.

A few cells of battery will be ample to run this motor at a good speed and its operation will be found to be very satisfactory.

(To be concluded)

A Step Down Transformer

Those who wish to use a heavy low-voltage alternating current can accomplish this by constructing a step down transformer. It is made from material readily procured without much expense.

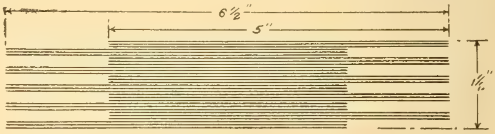


FIG. 1. MANNER OF BUILDING UP THE CORES

Cut from the softest sheet iron, as thin as possible, strips 1½x3¼ inches sufficient to

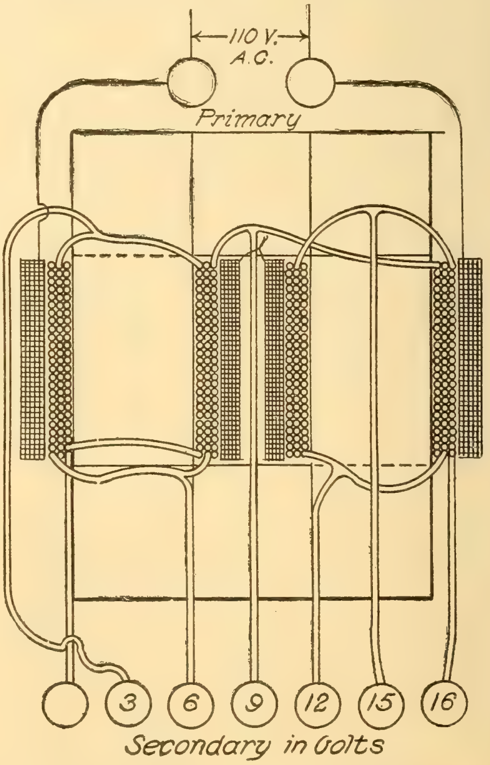


FIG. 2. HOW THE COILS ARE WOUND

make a mass three inches thick, and also more strips 1½x5 inches and sufficient to make a mass three inches thick.

Of the five-inch strips build two cores in the manner shown in Fig. 1.

When assembled clamp tightly in a vise and wrap with at least three layers of good friction tape.

Wrap each core very evenly with three layers or 2¼ pounds of No. 12 double cotton covered copper wire, 25 turns to the layer.

At the end of each layer make a tap to the binding posts as follows: The wire at the start is connected to the post not marked in Fig. 2, the end of the first layer to post marked (3) and the next layer to post marked (6), and so on consecutively.

The wire should be in one continuous piece, tappings being made to the binding posts.

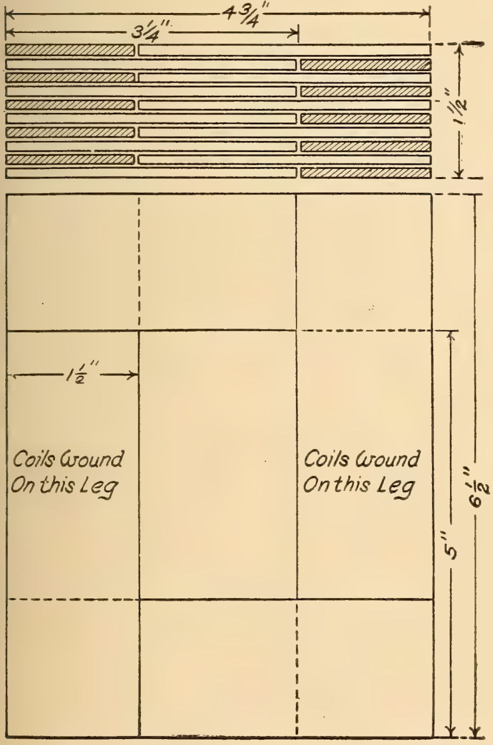


FIG. 3. METHOD OF ASSEMBLING THE CORE

Observe the direction of the winding so that it will be correct (Fig. 2).

Now over the heavy wire on each core wind six layers or 1½ pounds of No. 22 single cotton covered copper wire, 67 turns to each layer, a good bond paper being used between each layer and also between them and the heavy wire. The last layer should then be shellaced with orange shellac.

The core as seen in Fig. 1 is built up in groups of three sheets, although it is not essential, but more convenient and quicker.

Place the 3¼ inch strips in the spaces left on the two core pieces forming the rectangle shown in Fig. 3.

Across the ends of the rectangle place binding boards six inches long and 1½ inches wide by ¾ inch thick. Four of these are used, two on each end. Bolts are used to clamp them together.

Miniature Car and Controller

The accompanying picture is from a photograph of a miniature car and controller built by J. M. Ravenna of Houston, Tex. The car is built for a track of two-inch gauge, and the current which operates it is delivered at a pressure of ten to twelve volts. The axles are insulated in the wheels and the motor takes its current from three brushes on the wheels. By the use of the rheostat and transformer shown at the right it is possible to get current from the lighting circuit at anywhere from two to 60 volts.

MINIATURE ELECTRIC CAR AND CONTROLLER

Solder for Aluminum

This formula for soldering aluminum has been found to be a very good one: Take an alloy composed of 6 parts of aluminum, 2 parts of zinc and 4 parts of phosphor tin. Stearic acid is used as a flux, and the sluggish solder is pushed along the seams by means of an iron wire.

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine will be devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

A High-Power Wireless Equipment

By ALFRED P. MORGAN

CHAPTER VII.—HOT-WIRE AMMETER

Some means must be employed to determine when the current flowing out through the aerial is at a maximum. Advantage is taken of an instrument called a hot-wire ammeter which depends for its operation upon the expansion of a conductor when heated by a passing current of electricity.

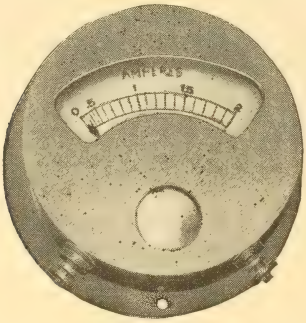


FIG. 77. HOT-WIRE AMMETER

Fig. 77 is from a photograph of a hot-wire ammeter for measuring high frequency currents. A short length of platinum iridium wire or an alloy known as platinoid is stretched tightly between two posts so arranged that practically all the current surging through the aerial passes through the wire and generates heat in proportion to the amount of current flowing. The heat expands the wire and causes it to become slack. The wire is connected to a silk thread which passes around a spindle bearing a pointer at its upper end. A spring is placed on the spindle to draw the silk thread taut. When the tension of the silk thread is relaxed through the expansion of the wire, the tension of the spring turns the spindle and moves the pointer across the scale.

Figures 78, 79 and 80 are detailed drawings of the case of the instrument. The base is a circular brass casting five inches in diameter and 1-16 of an inch thick. A ring, four inches in diameter and ¼ inch thick, is cast on the base to furnish support for the side. The two small raised portions (RR) are about ⅛ inch high and are for the purpose of raising the working parts of the instrument clear from the base. The holes in the centre are threaded with an 8-32 tap. The holes (SS) serve to fasten the dial supports to the base. The meter may be mounted on a switchboard if three holes (HHH) are bored equidistantly around the rim. The

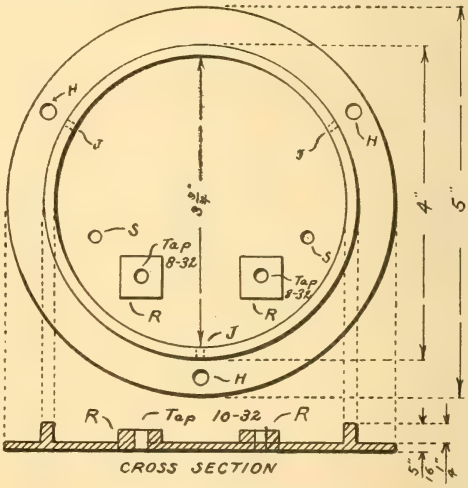


FIG. 78. CAST BASE

small holes (JJJ) bored in the ring immediately opposite (HHH) are threaded with a 4-36 tap to receive the screws which hold the case together.

The sides of the case are formed by a circular piece of brass tubing four inches in diameter and $1\frac{1}{2}$ inches high.

The cover is a casting somewhat similar to the base in that it has a similar ring of the same diameter. A long curved opening $\frac{7}{8}$ inch wide is cut out in the position indicated in Fig. 79 so that the graduations on the scale may be seen. A circular opening $\frac{7}{8}$ inch in diameter immediately above the hairspring adds considerably to the appearance of the instrument but is of no real value. Three small holes (OOO) are bored in the ring and threaded with a 4-36 tap immediately opposite those in the side of the case near the upper edge so that the cover can be fastened firmly in position by means of three small screws.

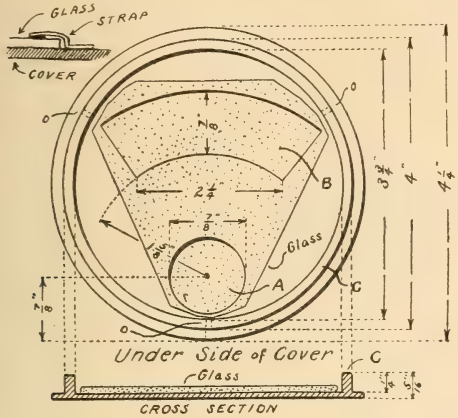


FIG. 79. DETAILS OF COVER

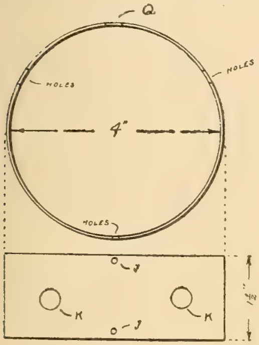


FIG. 80. CASE

A triangular shaped piece of glass is fastened to the under side of the cover below the openings so as to exclude dust and prevent injury to the working parts. It is held in place by three strips of copper soldered to the under side of the cover and then bent down against the glass. A few dabs of sealing wax or jeweler's cement judiciously placed will prevent the glass from rattling.

A top view of the working parts of the instrument is shown in Fig. 81. The body is made up of two brass castings (E) and (F). It is not necessary, however, that these parts shall be castings, and if desirable they may be cut out of sheet brass and bent. The details and dimensions of (F) are clearly understood from Fig. 82. Two slots are cut with a hacksaw into the arms of the casting to permit the insertion of a piece of flat steel clock spring. The two holes (GG) provide for the support of the pillars (RR) to which the "hot wire" is fastened. The other two holes (LL) permit two screws to pass through and clamp the casting to the base.

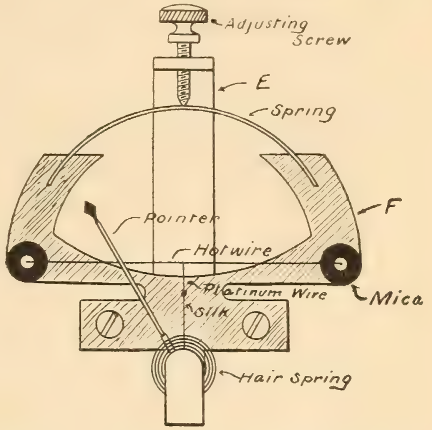


FIG. 81. TOP VIEW OF WORKING PARTS

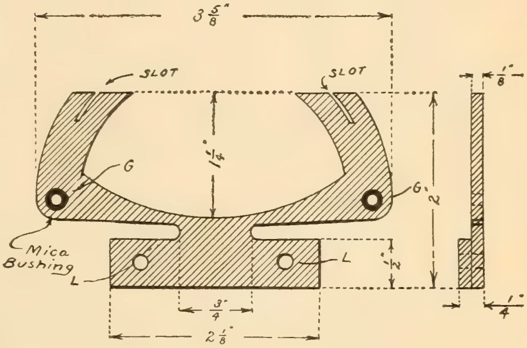


FIG. 82. DETAILS OF CASTING

The hot wire is a piece of No. 28 B. & S. gauge platinum iridium wire or platinoid about $3\frac{1}{4}$ inches long. It is stretched tightly between the two pillars (RR) and soldered. The pillars (Figs. 81 and 83) are two 8-32 round headed brass machine screws ⅝ inch long under the head. The threads are cut off for a distance of 5-16 inch on each. Some mica washers ½ inch in diameter are placed over each of the pillars which are then slipped into the holes (GG) in the casting (F). The holes (GG) are lined with mica bushings which insulate the pillars. More mica washers are placed around the pillars between the casting and the threaded washer (W) which may then be screwed down tight.

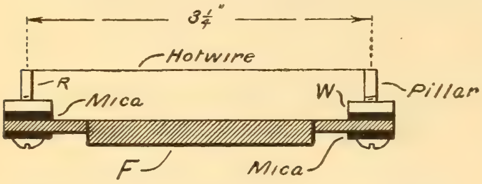


FIG. 83. ARRANGEMENT OF HOT WIRE

A piece of fine platinum wire (No. 36 B. & S. gauge) is fastened to the centre of the wire and connected to a silk thread.

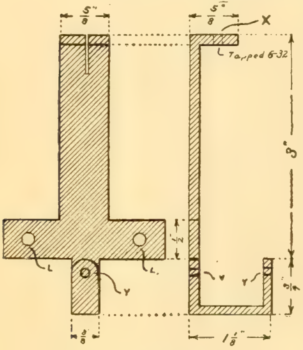


FIG. 84. DETAILS OF CASTING "E"

In case it is desirable to make the range of the instrument greater and increase the reading do not use wire larger than No. 28 B. & S. gauge or the resistance offered to high frequency currents will be greater than the resistance of the same wire to continuous currents and it will be difficult accurately to calibrate the scale. Instead of a single wire of large diameter use a number of fine wires in parallel.

The brass casting (E) (Figs. 81 and 84) is 3¾ inches long and 2⅛ inches wide at the widest point. The holes (YY) are bored and threaded to receive two small bearing screws having a conical depression bored in the end of each to receive the tapered ends of the shaft or spindle.

The hole (X) is threaded to receive a thumb screw (T). A piece of flat steel spring is fitted into the slots in the ends of the casting (F). The thumb screw presses against the centre of the spring which in turn varies the distance between the ends of the casting where the hot wire is supported by the pillars. When the thumbscrew is turned so as to increase the tension of the spring the ends of the latter press on the casting and force them apart. Vice versa, when the tension is relaxed the ends of the casting are brought closer together. Thus the tension of the hot wire may be varied at will and any expansion or contraction due to atmospheric temperature changes provided for.

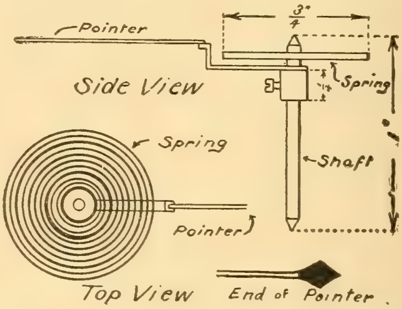


FIG. 85. DETAILS OF HAIRSPRING, ETC.

The details of the moving parts are shown in Fig. 85. The hairspring is ¾ inch in diameter and must be powerful enough to keep the thread and wire perfectly tight. The spring is mounted on the upper end of a spindle one inch long. The ends of the spindle are pointed so as to reduce friction as much as possible. The pointer is a piece of No. 22 B. & S. gauge aluminum wire having one end flattened and shaped like an arrow head. The top side of the pointer near the end is blackened so that it will contrast with the white paper scale and may be easily seen. The pointer is held in position by riveting to a small brass strap carried on the spindle. The outside end of the hairspring is soldered to a small pin on the casting at the point (Z). The strap to which the aluminum pointer is riveted is carried by a brass collar fitting around the spindle and held in position by a small set screw. The pointer may thereby be moved and set at any position on the scale to one side of centre where it may be desirable to have zero. The silk thread connecting with the hot wire is wrapped once or twice around the scale and fastened to the set screw. The parts should move easily and without friction.

The dial is formed by a piece of linen paper pasted on a piece of No. 22 B. & S.

gauge sheet brass cut to the dimensions and shape indicated in Fig. 86. The dial is supported on two brass pillars (P) (Fig. 86) ¼ inch in diameter and 1¼ inches long. The ends are bored out and threaded with a 4-36 tap. The lower ends are fastened to the base by means of two screws passing through the holes (SS), Fig. 78. The scale is fastened to the pillars by two 4-36 round-headed brass machine screws passing through the holes (M) and (N), Fig. 87.

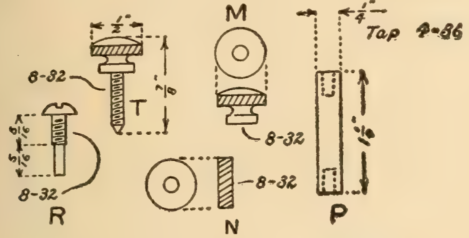


FIG. 86. DETAILS OF PARTS

The binding posts are illustrated in Fig. 86. The screws pass through the holes (KK) in the side of the case (see Fig. 80). The posts must be very carefully and thoroughly insulated from the case of the instrument by means of mica washers and bushings. A flexible stranded wire is soldered to each of the binding post screws and then led to the ends of the hot wire, where it is soldered to the washer (W).

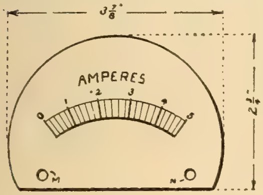


FIG. 87. DIAL

Before putting on the cover and fastening it in position it is necessary to graduate or calibrate the scale. This is accomplished by connecting the meter in series with a rheostat and another instrument which is a standard or has previously been calibrated. By sending a current through the meters the value can be determined by reading the standard and marking the divisions on the other with a pen and ink.

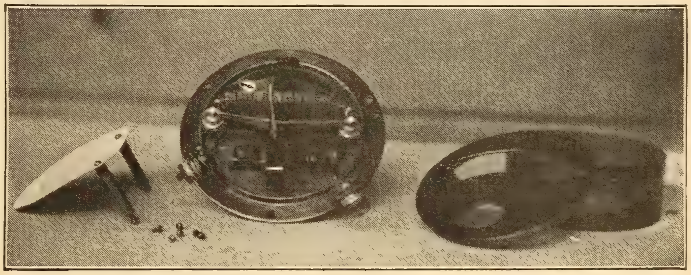


FIG. 88. HOT-WIRE AMMETER DISSECTED

The scale may be given almost any desired range by placing shunts in parallel with the hot wire. For instance, the meter without any shunt has a range of only one ampere. That is, a current of one ampere passed through the meter will move the needle all the way across the scale. The meter should, however, have a range of at least five amperes since it is to be used in tuning the station under description. This is accomplished by coiling up some No. 20 B. & S. gauge enameled wire around a pencil to form a sort of spring. This is placed in parallel with the hot wire by connecting to the washers (W). The amount of wire is regulated until it takes about five amperes to move the needle all the way across the scale. Then solder the wire to the washers so as to make the connections permanent. Fig. 88, which is from a photograph of the parts of the instrument, shows the shunt very plainly. Fig. 89 shows a side view of the movement.

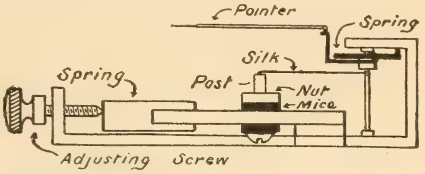


FIG. 89. SIDE VIEW OF MOVEMENT

The case of the instrument may be finished by polishing and lacquering or by oxidizing.

Fig. 90 shows the position of the hot wire ammeter in the circuit. To adjust the circuits, set both of the movable helix clips (A) and (B) on a turn of wire near the centre of the helix. Press the key and watch the needle on the meter. It will probably move very slightly. Then move both contacts together to a new spot, press the key and watch the meter. After trying the various turns of wire fasten the contact (A) at the spot which gives the highest reading on the meter and move the contact (B) alone until the reading is still higher and the maximum amount of current is shown to be passing out through the aerial. The circuits are now in tune with the exception of the spark gap which may need some adjustment. The proper gap length will readily be shown on the meter.

Unless the shunt on a hot-wire ammeter is fairly heavy it is not advisable to leave it continuously in circuit. Such is the case in this instance.

After once adjusting the circuits do not alter the amount of condenser capacity or the length of the leads, etc., without returning.

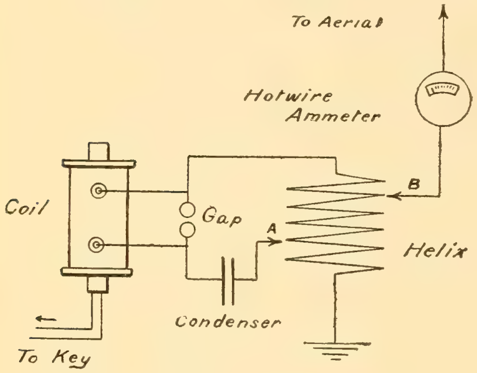


FIG. 90. CIRCUIT

[Note: My attention has been called to an apparent error in Part III, describing the construction of the induction coil secondary. In the text it is stated that "about fifteen pounds of No. 28 B. & S. gauge silk covered wire is required to wind the 50 sections." By calculating the space to be occupied by the wire it would appear that very much more than fifteen pounds of the wire would go in the space. But I have taken the coil, which was used as the basis of my figures, apart and find that the secondary, with the separators and wax weighs 26½ pounds. It is very probable that the separators and wax weigh 11½ pounds, so that the actual weight of the wire is about 15 pounds, as my notes show; although it was about three years ago that I wound this particular coil. I find also that in making the coil I placed a blotting paper separator next to each flange, which cut the apparent space in half. Also the wire, being passed through an impregnating bath, is heavily coated with wax, so that in actual practice much less wire could be wound in a given space than theoretically would go in.—Author.]

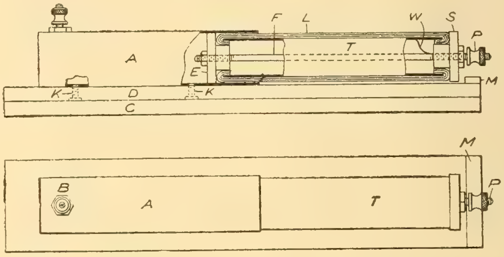
(To be continued.)

High Tension Variable Condenser

By A. B. COLE

It is well known that the proper capacity is essential in obtaining the highest efficiency from a given transmitting outfit, and it is practically impossible to vary capacity gradually with the ordinary types of condensers. The writer has therefore designed a variable high tension condenser suitable for sets from the smallest up to those using a two-inch spark coil. This form of condenser may be employed in stations of higher ratings by increasing the thickness of the insulating material, and increasing the length and cross section of the tubing.

The base of the condenser is made of wood, fibre or hard rubber, and is composed of two pieces (C) and (D), each 13 by 2½ by ⅜ inches. A square brass tube (A), 6 by 1½ inches (outside measurement) by 1-16 inch thick, which can be supplied by large hardware houses, is fastened to (D) by two 8-32 screws (K), which pass through threaded holes in (A). The ends of (K) projecting into (A) should be filed off flush as shown in the figure. The screws of ordinary dry battery binding posts may be used for this purpose. The lower base (C) may then be nailed or screwed to upper base (D). A double base of this kind is employed so that there will be no opportunity for the high tension currents to pass from (K) to any material upon which the condenser may rest.



HIGH TENSION VARIABLE CONDENSER

Another dry battery binding post (B) is soldered to (A) as shown in the figure.

(T) is a square brass tube 6 by 1⅛ inches (outside) by 1-16 inch thick. Eight layers of Empire cloth, sometimes called "oiled muslin," are wound tightly around this tube, and the ends are pushed into the ends of the tube. The Empire cloth should be procured in one piece 1-64 inch thick, seven inches wide, and 42 inches long. (E) is a wood, fibre, or hard rubber block, 1⅛ inches square, with a square projection ⅝ inch square and ¾ inch long, which fits into (T) over the Empire cloth which has been bent in. (S) is a block similar to (E). A round brass rod (F) passes through a hole in the center of (E) and of (S). This rod is threaded at each end, 8-32. At (E) a nut from a dry battery binding post is screwed on (F). One end of a short wire (W) is soldered inside (T), the other end being soldered to (F). This wire connects electrically (T) and (F). A binding post (P), screwed on (F), clamps blocks (E) and (S) so that the Empire cloth cannot move along (T), and also serves as a binding post to which a wire may be connected, so that a circuit may be made from the transmitting apparatus to (F), and from (F) to (T) through wire (W). A wood strip (M) prevents (T) from being entirely withdrawn from (A).

A WIRELESS SQUAD AT WORK DURING THE CHICKAMAUGA MANEUVRES

When (T) is entirely within tube (A) the condenser has a maximum capacity, and when withdrawn entirely from (A) the capacity is zero. At any intermediate point the capacity is directly proportional to the distance (T) has moved from the zero position. The spark gap should never be more than one inch long when this condenser is connected, as the high voltage of a longer gap might break down the resistance of the Empire cloth. Since, however, the gap should always be shorter than this in small stations, the above is not a disadvantage.

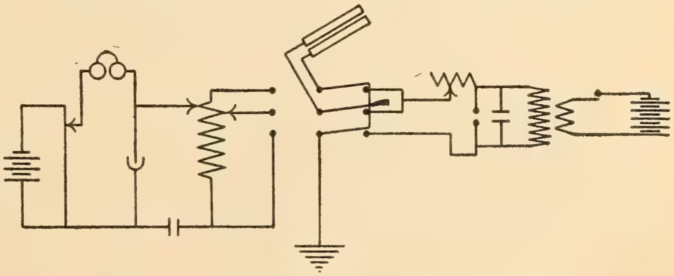
Wireless Messages at Chickamauga

Times have changed at Chattanooga since the days of Grant, Sherman, and Fighting Joe Hooker. Where forty-seven years ago messengers picked their way carefully from hill to hill at the very peril of their lives, today wireless messages are flashed over historic valleys while war maneuvres are at their height. The July encampment of soldiers from several southern states who gathered at Chickamauga, was marked by many brilliant movements, the combined success of which depended in no small degree on the efficiency of the wireless apparatus. The illustration shows a wireless squad of today at work on the historic battlefield. The receiving instruments are contained in a compact case and the aerial is a portable one.

Anchor Gaps and Sending

Many wireless amateurs use the looped aerial with good results in receiving, but find it not satisfactory in the matter of sending on account of the anchor gap. I use the following connections to eliminate this gap and still keep the looped aerial. A three-pole double-throw switch is attached to the aerial as shown.

—B. Francis Dashiell.



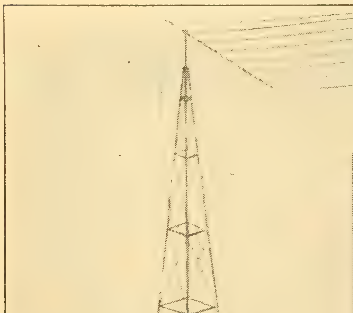
CONNECTIONS OF RECEIVING INSTRUMENTS

Wireless in Modern Journalism

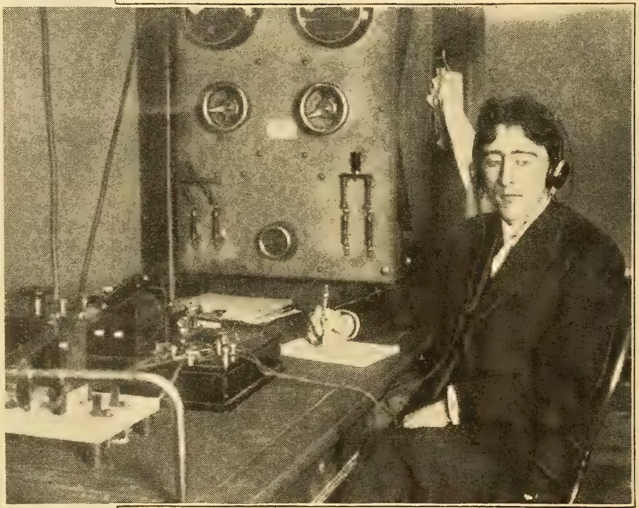
By C. B. EDWARDS

The Boston Herald was the first newspaper in New England to install wireless telegraph apparatus for use in connection with its news gathering service. This innovation in modern journalism was first adopted by the Herald in May, 1909, and quickly developed into one of the most useful features of the publication. Recently, in order to widen the range of the service, the instruments were removed from the rear or mechanical building of the Herald's plant into the front or business building, the height of the tower increased to 97 feet and the transmitting apparatus given two kilowatt strength, resulting in a marked extension of the range of the plant's activities.

With the new apparatus it is possible for the Herald operator to send and receive messages over distances as great as two thousand miles under the most favorable conditions. The Isthmus of Panama is within the sweep of the powerful waves of ether, and all shipping within 1,000 miles of the station, if equipped with the apparatus for sending wireless waves, can communicate with the Herald's operator. Cold winter nights present the best conditions for extreme distance work, and as a general rule the results in the night time are better than in the day time. In conjunction with the more than 500 existing wireless stations the Herald's plant has direct or indirect connection with the whole world. In straight lines or zigzags, from Cape Cod to Poldu, in Cornwall, England; from Scandinavia to Zanzibar; from India to China and Australia, and thence to Japan, Hawaii and California, the wireless waves can encircle the planet. About 120 transatlantic ships carry the wireless equipment and fully 350 ships of the mercantile marine are similarly equipped.



BOSTON HERALD'S WIRELESS ANTENNA



BOSTON HERALD OPERATOR AT STATION

In the Herald apparatus, the highest possible degree of electrical output and receptivity is accomplished by means of

T-shaped antennæ 220 feet long erected on the top of the Herald building. When these antennæ are charged with high voltage current the impulses strike the ether into vibratory waves which, varying from 100 yards to about six miles in length, which rush out, expanding as they go, at the rate of 186,000 miles a second—the speed of light itself. The tremors produced are practically simultaneous everywhere as hemispheric waves. If enough energy could be used a wireless impulse from the Herald would reach Newfoundland, and Bermuda about the same instant, 1-270th of a second after it was emitted. Cuba and the coast of Greenland would be reached about 2-270ths of a second from the time the operator discharged the current. England, Alaska, the Pacific Coast, Norway, France, Spain, Morocco and the coast of Brazil would receive the impulse 4-270ths of a second after it was given, and in double that period it would be received in Japan, Thibet, Persia, Egypt, the Gold Coast, Argentina and Peru. In 1-30th of a second the energy would travel from Boston to the Equator.

The receiving apparatus has been improved upon greatly in the recent changes made in the Herald's plant, especially in connection with the detector. In the most sensitive receiver known, advantage has been taken of the fact that the arriving ether waves can be made to break down the polarization in a tiny electrolytic cell as they pass through it, and thus increase its conductivity, which falls to normal when there is an intermission in the wireless pulses. The receiver includes a cell, shaped like a diminutive glass tumbler, half-filled with dilute acid. Two exceedingly fine, glass-coated platinum wires, in contact with the solution at their extremities, dip into the cell. The fluid between them forms part of a local circuit in which a telephone is included. A feeble battery current is kept moving through the circuit, but as the current is steady, the telephone gives no sound. When a wireless wave strikes the antennæ, its oscillating current passes through the receiver and breaks down the polarization between the ends of the platinum wire, increasing the conductivity, allowing the flow of an increased amount of current through the local circuit and reproducing the sound in the telephone.

The Herald operators use both the American and Continental Morse codes. The American code is shorter in sending English by about five per cent, but the difference in speed does not seem to some operators a perceptible factor. American coastwise steamers use the American code; transatlantic ships use the Continental code. It is impossible for operators acquainted with only one of the codes to receive messages in the other.

There are three operators in the Herald's wireless room. The first reports for duty at six a. m. and remains at his table until two p. m. The second man then takes charge of the instruments and remains until midnight. After that one of the Herald's regular telegraphers handles the wireless instruments until four a. m., after which the room is closed until six a. m. The first duty of the operator is to put on his telephones, open his switch and listen for calls. Maybe he will hear a fruit steamer calling for Manhattan Beach, or a transatlantic liner striving to get into communication with Sandy Hook, or a battleship coding a message to Charlestown Navy yard. Or maybe the first interruption to the silence will be from some Back Bay amateur. By and by, when the call for "B. H." comes, the operator is all attention, as that is the wireless code address of the Boston Herald. About the middle of the afternoon ships begin to report, and with these the operator is busily engaged a large part of his time.

When the baseball season is well under way, every steamer within hailing distance of the Herald office wants the baseball scores. On board the battleships, especially, is there great interest in this feature of the daily news and eager queries from the jackies are received by the Herald's operator within a quarter of an hour after the games are concluded.

Some idea of the wide range covered by the Herald's wireless service may be obtained by a half hour's stay in the room with the operator. One moment the operator is carrying on a conversation with a Hamburg American steamer bound south from New York to Kingston; later a string of messages may come from a Savannah Line steamer; then may follow communications from boats of the Eastern steamship line or from the oil steamers or the boats of the American Mail Company. A short time ago the Herald operator got into communication with the Scandinavian American line steamer Heligolav, 800 miles at sea. Early afternoon reports are received from steamers leaving

Boston Harbor and constant communication is maintained with the steamers between New York and Portland. In the summer season the steamers Harvard and Yale between New York and Boston have had continual wireless communication with the Herald.

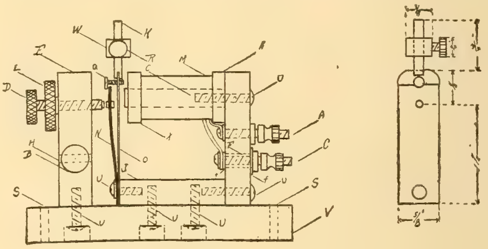
Between Boston, Providence and New York the number of wireless messages is constantly increasing. The great advantage of wireless communication between Boston and New York was picturesquely shown during the great blizzards of Christmas and mid-January. With miles of wires down in every direction and the utmost difficulty being experienced in handling telegraphic business by the old methods, the Herald operators quadrupled their daily quantity of messages and experienced no trouble in maintaining uninterrupted communication between the two cities.

In so far as possible the operator works directly with points for which he has messages. If, for instance, he receives a message addressed to a steamer off Cape Hatteras, he arranges the selectivity of his apparatus and then sends off into the air a 60,000 volt call. If he has a fairly good idea of the location of the desired steamer, he generally has little difficulty in reaching her within a few minutes. His apparatus is so delicately adjusted that he can practically make certain of his direction without resorting to many preliminaries. As soon as he receives the steamer's acknowledgement he proceeds to send the message. A system of relays is used for points beyond the practical and usual range of the Herald's plant. Messages for Kingston, Jamaica, for instance, are sent to the United Wireless station at Cape Hatteras, thence relayed to Tampa and from that point to Kingston. Notice of the arrival of such a message at its destination is usually received within fifteen minutes from the time it is sent.

The greatest long distance record made by the Herald's wireless apparatus is described in the February "log." About three a. m., on the 14th of February, Operator Brown, after arranging the "selectivity" with especial regard for long distance, was amazed to find himself listening to the dot and dash call of the station at San Juan, Porto Rico. For a quarter of an hour or more he had no difficulty in deciphering the words. With the approach of dawn the sounds became faint and finally ceased.

An Independent Interrupter

It is often desirable to have the coil of a wireless outfit at some distance from the key which controls it, and as the interrupter should be readily accessible for adjustment at all times, an independent interrupter, which takes up little space, and can therefore be placed near the key, is a very useful part of a wireless equipment. Small spark coils, as furnished by the manufacturers, have the distinctive interrupters of the makers, and all these have one fixed speed of vibration, and adjustment for high or low notes is almost impossible. The interrupter described in the present article may be adjusted for all speeds within wide ranges, and so will prove very satisfactory to owners of coils who wish to experiment with various frequencies.



INDEPENDENT INTERRUPTER

The base (V) may be made of wood, hard rubber, slate or marble. Slate answers the purpose well, and is easily worked with the tools at the disposal of the average experimenter. (V) is four inches long by 2½ inches wide by ½ inch thick. The standard (E), which is made from brass rod, ½ inch square and two inches long, holds the adjusting screw (D). The center of the hole for the adjusting screw is 1½ inches from the lower end. This hole, which is ⅛ inch in diameter, is tapped with an 8-40 thread. The hole (H) may be drilled at any convenient place. Set screw (B) is arranged to clamp a wire in (H), and has an 8-32 thread. (J) is of brass, ⅜ inch square, and supports the vibrator springs, (N) and (O), and also the brass upright, ⅜ inch square, which in turn supports electromagnet (M). The 8-32 machine screws (U) hold the various parts together as shown in the drawing.

The core (C) of electromagnet (M) is ¼ inch in diameter, and 1½ inches long, and is tapped with an 8-32 thread, at one end to hold screw (U). (C) is made of soft iron, and may be made from the core of an old electromagnet. The heads, (X), of (M) are of fibre, 3-16 inch thick, and ¾ inch in diameter. (M) is wound with two layers of No. 14 D. C. C. magnet wire. One end of this winding leads to binding post (A), which is connected to the brass upright, and the other end leads to binding post (C), which is insulated from this upright by means of the fibre tube (F) and the fibre washers (f). Both (A) and (C) are binding posts from the carbon terminals of old dry batteries, and have an 8-32 thread.

The vibrator consists of two springs (N) and (O), each having a thickness of about 1-32 inch. (O) is made of steel or iron, and (N) is of brass. A small machine screw (Q) is set 3-16 inch from the end of (O). This screw has a 2-56 thread. An aluminum weight (W), provided with a set screw (R), is supported by a brass rod (K), ⅛ inch in diameter, which is soldered to (O). The dimensions of the weight and rod are given in the drawing at the right of that of the interrupter. The contact points of the adjusting screw (D) and the spring (N) are of platinum or better, platinum-iridium, 3-32 inch in diameter. The points should be bought, already fastened to these parts, from a dealer in platinum. (D) is provided with a lock nut (L) as shown. (L) is about ¾ inch in diameter. The thread of (D) is 8-40. The holes (S) are for screws to hold the interrupter to the table or box on which it may be mounted.

When in operation the wire from the battery is connected to (E) at (H), and (C) is connected to one terminal of the primary winding of the coil. The regular interrupter of the coil is, of course, screwed down tight, so that it will not operate. A condenser of the same capacity as that of the coil is connected to (H) and (C).

When the key is depressed, the battery current flows from (H) across the contact points, down (N), around (J) to (A), and from (A) through electromagnet (M), back to (C), and from (C) to the coil. The passage of the current through (M) magnetizes core (C), which draws (O) toward (M). Screw (Q) strikes (N), and draws (N) away from the contact point of (D), thereby breaking the circuit. Breaking the circuit demagnetizes (M), and (O) and (N) return to their former positions, and the circuit is again completed. The same action continues as long as the key remains depressed.

The speed at which the interrupter will break the circuit may be regulated by moving (W) up or down rod (K). The duration of the contact between (N) and (D) depends on the length of the screw between (O) and (N). Thus by screwing (Q) down quite tight, a very short duration of contact may be obtained.

This interrupter will give a very wide range of adjustment, and will be found to be a desirable instrument in many experiments. It is suitable for use with coils from one-inch spark to four-inch spark.

WIRELESS QUERIES

Answered by A. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

One Mile Equipment

Questions.—(A) Would an ordinary telephone receiver work all right up to a distance of one mile? If so, what kind of detector would work best? (B) Could I string my aerial in the garret of my home, which is 24 feet long and 25 feet high, and get good results up to one mile? How many strands should I have for a one-inch coil, and what type should I use? (C) Which is the best way to connect the following instruments: one-inch coil, sending helix, spark gap, sending condenser, variable condenser, fixed condenser, single slide tuning coil, potentiometer, electrolytic detector, microphone detector, telephone.—G. C., Waukon, Ia.

Answers.—(A) An ordinary telephone receiver will work very satisfactorily to receive up to one mile from even a small station. We recommend a silicon detector for this purpose.

(B) In making an indoor aerial such as you describe, we should advise you to use not less than ten parallel wires at least as large as No. 18 B. & S., and to connect all the wires at each end, so that they will act as one wire. The lead in wire may be connected either at one end of the aerial, or at the center. We have received over a distance of about a half mile from a station using such an aerial in connection with a one-half inch coil. Of course an indoor aerial is not nearly so satisfactory as one outside the building, but it will do if nothing better is to be had.

(C) See diagrams (1) for sending and (5) for receiving, pp. 552 and 553 Oct. 1910 issue.

QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

Magnet and Pole Strengths; Transformer Ratio

Questions.—(A) Why is a piece of tempered steel or a nail put across the poles of a horseshoe magnet when not in use? (B) Is the north pole of a magnet stronger than the south pole? (C) Please explain what is meant by "ratio" when applied to transformers.—W. C. S., Biloxi, Miss.

Answers.—(A) By placing a nail or other magnetic metal in contact with both poles of a horseshoe magnet an easy path is afforded for the lines of force, thus preventing a certain amount of leakage. The magnet will therefore retain its magnetism longer with this armature in place than without it.

(B) No. This may be shown by floating a magnet needle on a piece of cork on the surface of a dish of water. The needle will arrange itself in a north and south position, but since there is no further motion imparted to the needle we must infer that the earth's magnetism has no greater effect on the north-pointing pole than upon the south-pointing pole.

(C) The relation between the primary and secondary turns or between the primary and secondary voltages of a transformer is referred to as the ratio of a transformer. To illustrate, assume a transformer having 100 turns of wire on the primary coil and ten turns on the secondary. It has a ratio of ten to one. Ten volts impressed on the primary would be stepped down to one volt, 1,000 volts to 100 volts, etc.

Drop in Voltage; Temperature and Resistance

Questions.—(A) Current is supplied to 200 16-candle-power, 110-volt lamps situated 100 feet from the center of distribution. Calculate the voltage drop between the center of distribution and the lamps. (B) If the resistance of 1,000 feet of copper wire at 90° F. is 100 ohms, what will be its resistance per foot at 75° F.?—F. E. K., Asbury Park, N. J.

Answers.—(A) One hundred amperes will be needed and No. 1 B. & S. gauge wire required by the code. The resistance of 200 feet of this wire is .0258 ohm. The formula for drop in voltage is:

$$E=I\,R$$

substituting, $E=100\times.0258$

$=2.58$ volts drop.

(B) Probably the most simple formula for solving your problem is:

$R_t=R_o\ (1+.004t)$ in which

R_t=resistance of a conductor at a given temperature, t.

R_o=conductor's resistance at 0° C.

Reducing Fahrenheit temperatures to degrees Centigrade:

90° F.=32.2° C.

75° F.=23.8° C.

Applying the formula

$$R_o=\frac{100}{(1+.004\times32.2)}$$

$= 88.5$ ohms at 0° C.

Again $R_t=R_o\ (1+.004t)$

$=88.5\ (1+.004\times23.8)$

$=96.9$ ohms, resistance of conductor at 75° F. or 23.8° C.

Decomposition of Water

Questions.—(A) How can I figure the amount of hydrogen and oxygen set free from water by a certain current? (B) Is water more readily decomposed by adding an acid or an alkali to it?—F. A. L., Valier, Mont.

Answers.—(A) One ampere-hour of current will set free 12.8 cubic inches of oxygen and 16.3 cubic inches of hydrogen.

(B) Electrolysis cannot easily take place unless the electrolyte is a conductor. Slightly acidulated water decomposes more readily than the water only.

Remedies for Patent Infringement

By OBED C. BILLMAN, LL. B., M. P. L.

Who may sue; Who liable to be sued; Evidence.

WHO MAY SUE.—The right of persons interested as patentees, assignees, or grantees to bring an action at law for damages or to file a bill for an injunction to prevent the violation of any right secured by a patent is expressly provided for by federal legislation.

Assignees.—A transfer of either, first, the whole patent, comprising the exclusive right to make, use, and vend the invention throughout the United States, or second, an undivided part or share of that exclusive right, or third, the exclusive right under a patent within and throughout a specified part of the United States, is an assignment, properly speaking, and vests in the assignee a title in so much of the patent itself with a right to sue the infringers, in the second case jointly with the assignor, and in the first and third cases in the name of the assignee alone. Any assignment or transfer short of one of these is a mere license, giving to the licensee no title in the patent and no right to sue at law in his own name for an infringement.

Personal Representatives and Trustees.—A suit for an infringement of a patent may be brought by a personal representative or trustee.

Licensees.—In equity, as at law, when a transfer amounts to a license only, the title remains in the owner of the patent, and suit must be brought in his name and never in the name of the licensee alone, unless that is necessary to prevent an absolute failure of justice, as where the patentee is the infringer and cannot sue himself. Any rights of the licensee must be enforced through or in the name of the owner of the patent, and perhaps, if necessary to protect the rights of all parties, joining the licensee with him as plaintiff.

WHO LIABLE TO BE SUED.—A discussion of the question who are the proper parties to be made defendants is not properly within the scope of a treatment of the substantive law of patents, and may be found in full elsewhere. As to the question who is liable for an infringement, the general rule is that any one who has infringed a patent may be sued by the patentee, grantee, or assignee.

Personal Representative.—An action for the infringement of a patent survives and may be brought against the personal representative of the infringer.

Principal and Agent.—A principal may be liable for an infringement committed by his agent, in accordance with the general rule making a principal liable for the torts of his agent. The general rule is that both agents and servants are liable for infringements committed by them. It has been said, however, that a mere workman or servant who makes, uses, or vends for another, under his immediate supervision, a patented article, is not liable in an action at law for damages which may have been sustained by the patentee by reason thereof.

Officers and Agents of Private Corporations.—The general principles governing the liability of the officers and agents of private corporations for torts has been stated elsewhere. The decisions as to their individual liability for infringing patent rights are somewhat conflicting. The rule deducible from the best-considered cases seems to be that the officers, directors, and stockholders of a corporation who have the management and superintendence of its business, or its agents who are concerned in conducting its business, are individually liable for the infringement of a patent.

County or Municipal Corporation.—A county or municipal corporation may be liable for the infringement of a patent.

The United States is not liable to a suit for the infringement of a patent, this being an action sounding in tort, and the United States not having consented to be liable in tort. But officers or agents of the United States, although acting under the authority of the government, are personally liable for their own infringement of patents. So a private person or contractor supplying the government with articles embodying the patented invention may be sued for infringement.

EVIDENCE.—*Questions of Law and Fact.*—The question of identity between the patented device and the alleged infringing device is one of fact for the jury, under proper instructions from the court, except where it turns upon the construction of the specifications and claims, in which case it is one of law for the court.

Presumptions and Burden of Proof.—Upon the issue of infringement, the burden of proof is upon the complainant. To sustain this burden of proof, the evidence must, of course, show the existence of facts constituting infringement. What these facts are has been already treated. The evidence will, of course, vary according to the circumstances and the nature of the infringement, and is subject to the usual rules of evidence. A comparison of the models or devices themselves is the best mode of determining the question of identity or infringement. The presumptions and burden of proof as to the validity of letters patent have been considered in the various sections of this title dealing with the particular questions upon which the validity of a patent may be assailed.

Expert and Opinion Evidence.—Expert evidence is admissible upon the question of infringement or identity where the question turns upon scientific principles or the meaning of technical terms. This class of evidence is subject to the usual considerations applicable in other classes of cases. The opinion of an expert does not necessarily require the submission of the question to a jury where the matter is otherwise plain. Facts are entitled to more weight than opinions. The jury is not bound by the opinions of mechanical experts upon a question of identity of improvement or construction.

Documentary Evidence.—Certified copies of patents and of other papers in the patent office are evidence in the same manner as the originals would be. In the case of other documents the usual rules of evidence apply.

BOOK REVIEWS

The Wireless Telephone. By H. Gernsback. New York: modern Electrics Publication. 1910. 78 pages with 52 illustrations.

This little volume is intended for the experimenter doing research work in wireless telephony. It takes up briefly the theory of the wireless telephone and the early experiments and then outlines the operation of some of the systems such as the Armstrong and Orling; spark system; McCarthy; Fessenden, Missbaumer Bathrick, multiple spark system, Majoranna, etc.

High Frequency Electric Currents in Medicine and Dentistry. By S. H. Monell, M. D. New York: William R. Jenkins Company. 1910. 465 pages with 30 illustrations. Price $4.00.

A wonder book of simple things; interest begins at once in the first chapter, in which electricity and its mysteries are defined. This particularly is conspicuous in the section, "Life Phenomena and Electricity," which tells what science has found out about how Nature works in the human body, all explained in the most interesting manner. Then follow two chapters on physiologic-medical properties of high-frequency currents, including a wonderful mass of convincing facts. And the section following these chapters concerning what others are doing with high-frequency currents will prove astonishing. Word pictures of treatment follow, and then twenty of the most absorbing chapters teaching in detail the advancement in treatment of various stages of diseases in which high-frequency currents can be made of benefit to patients. Every one of these twenty chapters is built on the physiologic foundation of the preceding sections.

Chats on Electricity. By Frank Broadbent, M. I. E. E. London: J. B. Lippincott Company. 1910. 192 pages with 25 illustrations. Price, $1.25.

Bearing in mind the rapid development of the electrical art and the difficulty most people find in even keeping up with its phraseology, the author has written this interesting and instructive book treating the subject in a non-technical manner to enable those who specialize to obtain a general idea of the whole field.

The first three chapters treat of the fundamental principles of electricity and electrical current and its measurements. The chapters following are devoted to the subject of electricity as a motive power and of the application to the many practical uses to which it is now put in the office and home. Wireless telegraphy is also considered. The author has evidently had much experience with both the theoretical and practical sides of the subject and in consequence has stated many useful facts and illustrated them with diagrams.

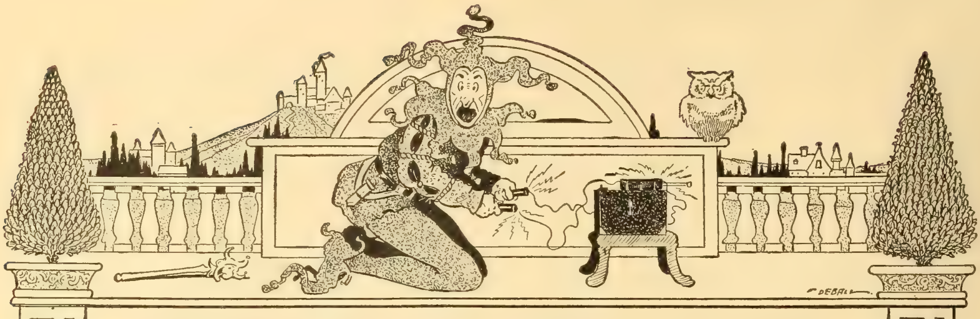
ON POLYPHASE SUBJECTS

The First Central Station History, as relating to the development of incandescent electric lighting, does not date back very far in years but a great way when measured by results accomplished. It was only about 30 years ago that Edison was making the first incandescent lamps, easily within the remembrance of many of the readers of this magazine. But so wonderful have been the changes wrought since those first experiments that to the majority of people today their significance has been lost in the "light" of present-day achievements. It is, therefore, our pleasure from time to time to set down in lasting form such of those historical incidents relating to the beginnings of the present great billion-dollar industry as will be of particular interest to the general public. A start was made in this direction in the issue of last January, when we printed Mr. Hinds' notable article, "In the Beginning," telling of the first commercial electric lighting plant in the world. Later, in the September issue, appeared "The Story of the Sunbury Station," by W. S. Andrews, followed, in this issue, by another by the same author on "Testing Electrical Apparatus a Quarter of a Century Ago." Mr. Andrews is not only the possessor of a pleasing style, but he also writes from personal experience, for as a young man he obtained employment in the Edison works, led on by the stories he had heard of the *wonderful electric lamp*.

In the December issue another of Mr. Andrews' entertaining articles will appear, entitled, "Some Account of the First Edison Central Station at Menlo Park, N. J., 1880-1881." He was able to write this interesting bit of history from his own personal notes and recollections. The article will be illustrated by a number of old halftones and zinc etchings, only one set of which is in existence. When you read this account you will be reading the true history of the first practical application of an epoch-making invention, written by a man who was there and helped in the work and read over and approved by no less a man than the great inventor himself—Thomas A. Edison.

A Hundred Years of Tin Cans Judging from the savings effected by its use and from the greater healthfulness due to the avoiding of chemical preservatives, the tin can might well have been entitled to an elaborate celebration of its recent hundredth anniversary. For it was in 1810 that Francois Appert, after six years of experimenting, introduced the method of preserving food by heating it in a can and then sealing the can. The French government promptly showed its appreciation by voting Appert a prize of $2,400—and the whole civilized world has profited by his plan ever since.

Now after a whole century the only notable improvements are in details of construction of the cans used for this purpose and in the methods of manufacturing the same. Thirty years ago automatic machinery for making and filling cans was introduced by the Norton Brothers of Chicago. But only during the last few years has electricity come into service, partly for heating soldering tools in the can factories and canneries and partly for driving the can-filling machines in the scattered canneries. Recently a number of canneries have also adopted electrically operated machines for pasting labels on the cans after they have been sealed. Besides, a number of plants have been experimenting with electrical methods of reclaiming the tin both from old cans and from the scraps left in making them. So while the first century of the tin can has been almost non-electrical, its second hundred years starts out with a modest use of electricity which may develop into an important factor before many more years have passed.



SHORT CIRCUITS

A young man called on a doctor, complaining of pains in his stomach. The doctor diagnosed the case as dyspepsia, and advised the patient to go home and try a dill pickle. If he could keep that on his stomach, he was to report to the doctor in the morning. The next day the patient returned, and when the doctor asked him if he could keep the pickle on his stomach, he replied, "I could as long as I stayed awake, but when I fell asleep, it rolled off."

* * *

A well-known French actor became involved in a discussion with an American, grew heated, drew his card from his pocket, threw it on the table with a tragic air and stalked out. The American regarded the card for some moments, then took out his fountain pen, wrote "Admit bearer" above the engraved line and went off to the theater.

* * *

At the first meal on board the ocean liner, Smythe was beginning to feel like casting his bread upon the waters. His friends had told him that when he began to feel that way he should stuff himself. He tackled a cutlet first, but it didn't taste right. He observed to the waiter, "Waiter, this cutlet isn't very good."

The waiter looked at his whitening face, then replied, "Yes, sir; but for the length of time you'll 'ave h'it, sir, h'it won't matter, sir."

* * *

Guest—Got any ham?
Girl (after looking at bill of fare)—Ain't got any.
Guest —Got any eggs?
Girl (looking again)—Ain't got any.
Guest—Well, what have you got?
Girl (looking once more)—Ham-and-eggs.

* * *

C. M. Paxton, general manager of the Dayton & Troy Electric Railway in Ohio, is a steam road graduate, but he has recently changed his views on the efficiency of steam road trainmen. He believes that the green man from the farm, properly instructed, makes the best trainman. Other able managers share this view. The other day on Paxton's road, a conductor gave the stop signal, but the car pulled a short distance beyond the road crossing. The conductor saw that the alighting passenger would have to step in the mud and poking his head out the door he yelled to the motorman, "Whoa, thar, back up about a hoe handle length."

* * *

Madge—She said I put rouge on my face to deceive people. Wasn't that mean?

Marjorie—It was, indeed, dear. The way you put it on doesn't deceive anybody.

* * *

The editor who gave up his seat to a lady on the train said he "was crowded out to make room for more interesting matter."

* * *

"The sea resort you were speaking of is a pretty gay place, isn't it?"

"I should say so! The only thing there that isn't dissipated is the fog."

* * *

They were heckling him at a political meeting. At last he could stand it no longer.

"Who brayed there?" he cried out sarcastically.

"It was only an echo," retorted somebody amid much laughter.

The teacher asked the boys if they could take off their overcoats. "Yes, sir," came the answer. "Can the bear take off his coat?" Silence. Then up spoke Willie. "Please, sir, no." "Why?" "Cause only God knows where the buttons are."

* * *

He was very bashful and she tried to make it easy for him. They were driving along the seashore and she became silent for a time. "What's the matter?" he asked. "O, I feel blue," she replied. "Nobody loves me and my hands are cold."

"You should not say that," was his word of consolation, "for God loves you, and your mother loves you, and you can sit on your hands."

* * *

A medical professor asked his class "if a patient swallowed a heavy dose of oxalic acid what would you administer?"

There was silence and finally one of the younger students murmured in answer, "spiritual consolation."

* * *

Diner—Change that chicken soup to turtle.
Waiter (shouting)—Make that chicken turn turtle!

* * *

Lives of humorists remind us
  Gags that are the most sublime
Are the ones that limp behind us
  Covered with the moss of time.

Jokelets that perhaps another
  Sailing o'er life's solemn main,
A forlorn and half-wit brother,
  Seeing, shall revamp again.

Let us then begin perusing
  Almanacs of ancient date,
Still a-seizing, still a-choosing
  Chestnuts that have learned to wait.

* * *

Neal Ball, the only ball player in the major baseball leagues who ever made a triple play unassisted—that is, put out three men in one play—is convinced that women are more intelligent on the average than men. He is equally convinced, however, that they don't understand baseball. Accordingly, when he talks baseball to a woman, he adopts a light, facetious tone.

"A woman once said to me," he tells the story, "'I love baseball, Mr. Ball. I love especially to watch the man at the bat. It is so cute, too, the way be keeps hitting the ground gently with the bat's end. Why does he do that, though?' 'Well, you see, madam,' I said, 'the worms have an annoying habit of coming up to see who's batting, and that naturally puts a man out a bit; so he just taps them on the head lightly and down they go'."

* * *

Minister—"And how did Noah spend his time in the ark?"

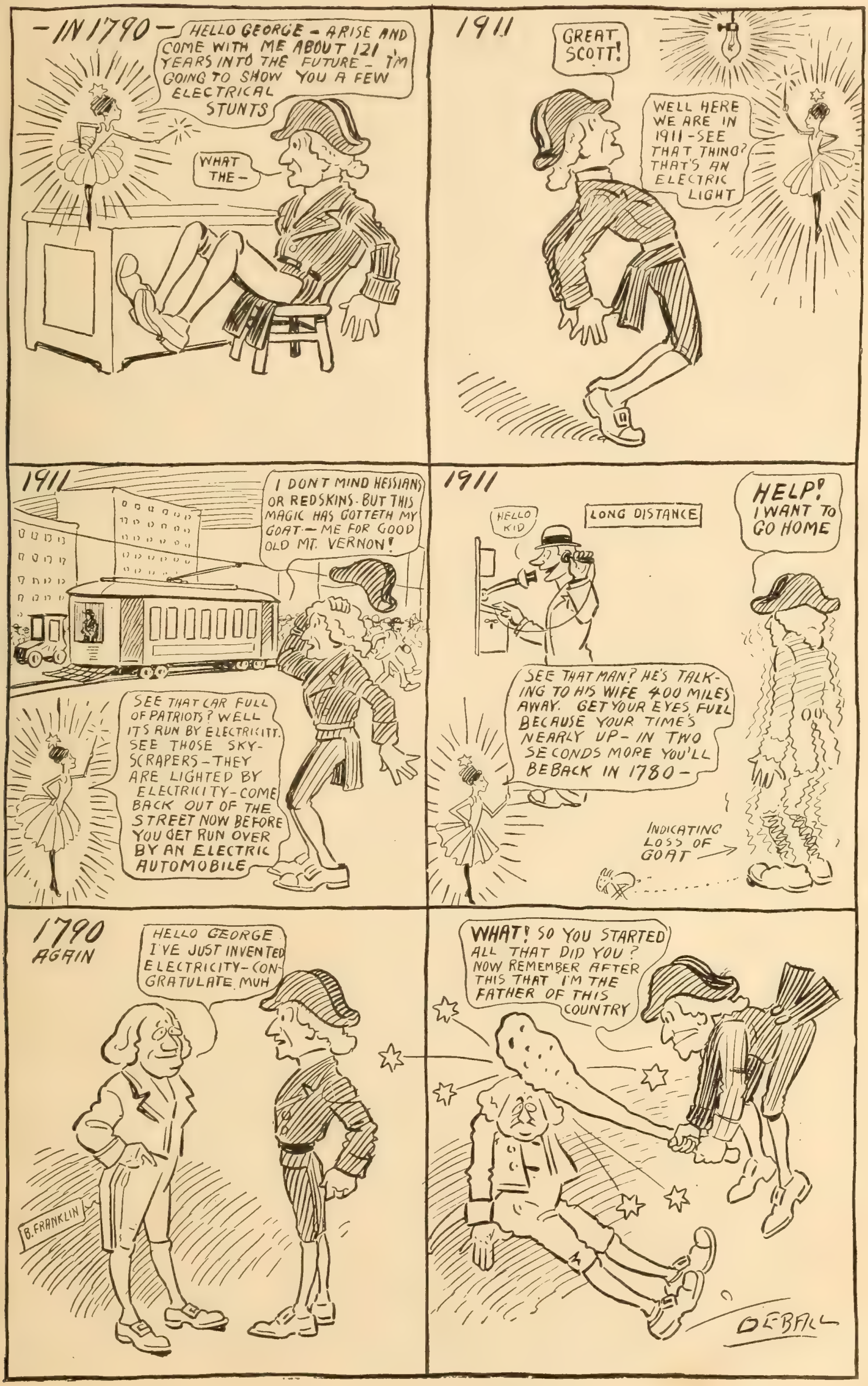
Small Boy—"Fishin'."

Minister—"A vera reasonable suggestion, my laddie."

Small Boy (guardedly)—"But he wouldna catch muckle."

Minister (surprised)—"What makes ye think that?'

Small Boy (knowingly)—"Because, ye see, he had only twa wir-rms!"


-IN 1790-
HELLO GEORGE - ARISE AND COME WITH ME ABOUT 121 YEARS INTO THE FUTURE - I'M GOING TO SHOW YOU A FEW ELECTRICAL STUNTS
WHAT THE -
1911
GREAT SCOTT!
WELL HERE WE ARE IN 1911 - SEE THAT THING? THAT'S AN ELECTRIC LIGHT
1911
I DONT MIND HESSIANS OR REDSKINS - BUT THIS MAGIC HAS GOTTETH MY GOAT - ME FOR GOOD OLD MT. VERNON!
SEE THAT CAR FULL OF PATRIOTS? WELL ITS RUN BY ELECTRICITY. SEE THOSE SKY-SCRAPERS - THEY ARE LIGHTED BY ELECTRICITY - COME BACK OUT OF THE STREET NOW BEFORE YOU GET RUN OVER BY AN ELECTRIC AUTOMOBILE
1911
HELLO KID
LONG DISTANCE
HELP! I WANT TO GO HOME
SEE THAT MAN? HE'S TALKING TO HIS WIFE 400 MILES AWAY. GET YOUR EYES FULL BECAUSE YOUR TIME'S NEARLY UP - IN TWO SECONDS MORE YOU'LL BE BACK IN 1780 -
INDICATING LOSS OF GOAT
1790 AGAIN
HELLO GEORGE I'VE JUST INVENTED ELECTRICITY - CONGRATULATE MUH
B. FRANKLIN
WHAT! SO YOU STARTED ALL THAT DID YOU? NOW REMEMBER AFTER THIS THAT I'M THE FATHER OF THIS COUNTRY
DE BALL

COMMON ELECTRICAL TERMS DEFINED

In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.

Calling Drop.—The shutter or armature which on a telephone switchboard drops and informs the operator that a subscriber is calling. In the earlier types the operator restored the drop by hand after getting the person called for. This required so much time that drops are now arranged so that when the operator makes the connection by plugging in on the board a spring is operated which throws the shutter into place.

Calorie.—The name of two different units of heat. By the greater calorie we mean the quantity of heat necessary to raise one kilogram or .45 pounds of water 1° C. The lesser calorie is the quantity of heat needed to raise one gram of water 1° C.

Candle-foot.—The light thrown upon a surface by a standard candle one foot away. The American and English standard is a sperm candle which burns two grains a minute. Must be burned ten minutes before it is used as a measure in order to secure accuracy.

Candle Power.—The amount of light given out by a standard English sperm candle. (See Candle-foot.)

Candle, Standard.—A candle of specified construction burning a specified amount of sperm per minute. (See Candle-foot.)

Canopy.—The metal shell placed at the base of a fixture to cover the insulating joint, outlet box and screws necessary in securing the fixture in place.

Canopy Switch.—Applied to the switch used in street railway cars to cut off the current from controllers and motors. One switch is located in each end of the car. Sometimes used to designate a small snap switch within the canopy of a chandelier operated by a pull chain or cord from below.

Caoutchouc.—The substance obtained by coagulation and drying the juice obtained from certain trees in the tropics. Commonly called India rubber, or rubber, the latter name being due to the fact that one of its first uses was for erasing pencil marks by rubbing. Of high value in the electrical field as an insulator.

Capacity, Dielectric.—In a condenser each pair of conducting surfaces is separated by an insulator or dielectric. The capacity of the condenser when so insulated as compared to its capacity when the conducting surfaces are insulated by air only is called its dielectric capacity.

Capacity, Electrostatic.—The quantity of electricity it is necessary to give to a body to raise its potential from zero to one is the measure of its electrostatic capacity. A crude comparison is found in the quantity of air needed in a bottle to raise its pressure a stated amount.

Capacity of Cable.—A cable like a Leyden jar or condenser has an electrostatic capacity. The armor or sheathing of the cable represents one coat, the wire conductors the other, and the insulator is the dielectric corresponding to the glass of the Leyden jar. The capacity is usually expressed in the unit of micro-farads per mile.

Capacity, Storage.—Applied to the number of ampere-hours of current a storage battery will furnish after being fully charged. More commonly known as the rating of a storage battery.

Carbon.—An element existing in three forms: charcoal, graphite and diamond. Graphite is the form most used in the electrical field. Its applications are numerous, as in batteries, in lamps as electrodes, in the carbon lamp as a filament, as contactors on motor-starters and circuit-breakers, etc. Because it does not melt except at an extremely high temperature, it is frequently used as a resistance in an electrical circuit.

Carbon, Cored.—An arc lamp carbon with a core of softer material than that on the outside. This kind of a carbon is believed to give a steadier light than a solid carbon.

Carbon, Telephone.—A telephone transmitter using carbon as a material whose resistance is varied by the varying diaphragm pressure. The Blake transmitter is constructed on this principle.

Carbon, Transmitter.—See Carbon, Telephone.

Carbon, Volatilization of.—The high temperature in the carbon arc causes the positive carbon to be vaporized and span the space between the two, moving from the positive to the negative. The temperature at which this occurs is supposed to be near 3500° C. This oval shaped vapor formation may be observed by projecting the image of the carbon tips upon a white screen by means of a lens.

Cardew Voltmeter.—An instrument made by Capt. R. E. Cardew. In its operation a current is passed through a fine wire, heating it and causing it to expand. This wire is so connected to a drum and gears that any movement in it due to expansion or contraction is transmitted to an index needle. As the current passed through the wire will be proportional to the voltage the instrument is calibrated to read the voltage direct. This voltmeter is unaffected by magnetic fields but cannot be used to measure very small differences of potential.

Carrying Capacity.—The number of amperes of electric current a wire will carry without becoming unduly heated.

Cathode.—The plate by way of which the current leaves a voltaic cell.

Cautery, Electric.—The use of a fine platinum wire heated to whiteness by an electric current to take the place of the surgeon's knife. Its use hastens the healing of the wound after the operation and in some cases operations have been performed with it when the use of the knife would not be possible.

Ceiling Block.—A block of insulating material usually of porcelain placed on the ceiling as a support from which a drop cord may be suspended. It is arranged to contain fuses. Called also a ceiling rosette.

Ceiling Button.—A block of insulating material like a ceiling rosette but containing no fuses, placed on the ceiling as a pendant cord support.

Ceiling Rosette.—See Ceiling Block.

May We Send You Free Samples

To Prove That You Can Artistically Color and Finish Any Kind of Wood About the Home

YOU can produce any desired shade and effect. The expense is slight—the work easy and simple. First apply Johnson's Wood Dye—made in 14 shades as listed below. Over the Dye lightly apply Johnson's Prepared Wax—and you have a beautiful, rich, subdued finish that will not mar or show scratches.

Johnson's Wood Dye must not be confused with colored varnishes or stains, which merely coat the surface of the wood hiding the natural grain beauty. Johnson's Wood Dye is not a mere stain—not merely a surface dressing—it is a deep-seated dye which goes to the very heart of the wood and stays there, fixing a rich and permanent color.

Johnson's Wood Dye

is made in fourteen attractive shades, as follows:

No. 126 *Light Oak*
No. 123 *Dark Oak*
No. 125 *Mission Oak*
No. 140 *Manilla Oak*
No. 110 *Bog Oak*
No. 128 *Light Mahogany*
No. 129 *Dark Mahogany*
No. 130 *Weathered Oak*
No. 131 *Brown Weathered Oak*
No. 132 *Green Weathered Oak*
No. 121 *Moss Green*
No. 122 *Forest Green*
No. 172 *Flemish Oak*
No. 178 *Brown Flemish Oak*

Pints, 50 *cents each*

Johnson's Prepared Wax

dries quickly over Dye or any other finish so that it may be brought to a beautiful, dull, artistic finish. It should be used for all woodwork, floors and furniture including pianos and is just the preparation for Mission furniture.

Johnson's Under-Lac

is not a common varnish—but a thin, elastic spirit preparation superior to shellac or ordinary varnish, and is to be used over Wood Dye where a higher gloss than a wax finish is desired, drying hard in half an hour. Best preparation for linoleum and oilcloth, bringing out the pattern as glossy as new. Gallons $2.50—smaller sizes down to half pints.

Fill out the coupon for free samples and booklet

S. C. Johnson & Son
"The Wood Finishing Authorities"
Racine, Wisconsin

Free Sample Coupon

Please send me free samples of Wood Dye, Shade No.................. Prepared Wax and Under-Lac—also Booklet. If samples are found satisfactory will ask my dealer to supply me.

Name..

Address..

P. E-11

In the series of eight test trips of the electric vehicle, conducted by Thomas A. Edison, the average mileage on a single charge of the battery was 118 4-10 miles--because the battery equipment was

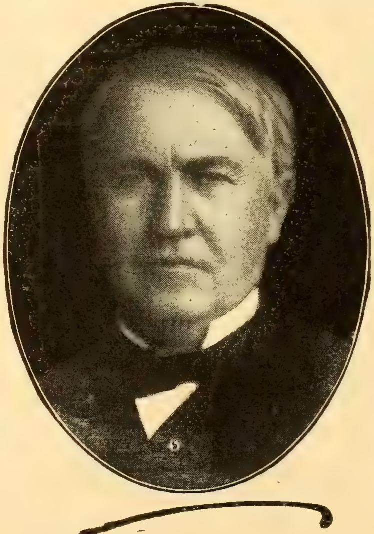
The New Edison Storage Battery

double the mileage obtainable with other battery equipment---and it will prove itself just as far superior, to other storage batteries for your requirements, no matter what those requirements are.

The Edison is radically different from all other storage batteries. Its weight, per capacity, is only about half that of the lead battery. It can't sulphate or deteriorate. It is not injured by overcharging, by too rapid discharge, by complete discharge nor by standing idle for any length of time, either charged or discharged.

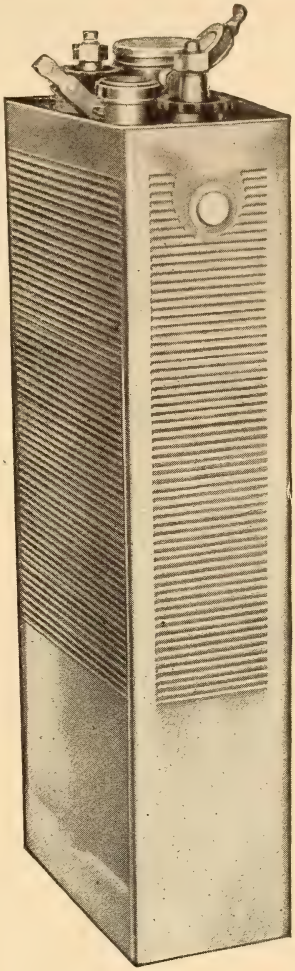
It requires far less care than any other battery. Its life is many times that of the lead battery.

Write us today, stating your battery requirements, and we will send you complete information.



Thomas A Edison

This is the Type A6 Cell of the New Edison Storage Battery



There is no lead or acid in its construction. The plates are nickel and iron in an alkaline (potash) solution.

No rubber or glass jars to crack or leak. The container is welded, fluted, rigid nickeled steel.

The only care that the Edison requires is to keep the cells clean externally and filled with *distilled* water. There is no constant renewal expense.

No matter what storage battery you are now using, the new Edison Storage battery will do your work better and far more economically.

Write us for full particulars today

THE EDISON STORAGE BATTERY CO.
117 Lakeside Ave., ORANGE, N. J.

It Seems Magical

With the Mazda Lamp you turn on the switch in exactly the same way as with the carbon lamp.

With the Mazda Lamp you replace the old-style lamp without change of socket or fixture.

The Mazda Lamp looks much the same as the carbon lamp—same base—same bulb—different wires inside.

Use Mazda Lamps

Your light bill will be no more at the end of the month; you have had three times the light; you have had better, whiter light, fewer headaches, fewer petty ailments, and all because you substituted Mazda Lamps for the old lamps. It does sound magical, but it isn't, it is exactly as stated.

The Mazda Lamp is the great improvement in electric lighting. It is the scientific perfection of the electric lamp. It will pay you to investigate.

Buy your lamps from any of the member companies listed on the opposite page or from their representatives everywhere.

National Electric Lamp Association

CLEVELAND

The following is a list of the Member Companies of the

National Electric Lamp Association

CLEVELAND

Call upon any of them for your lamp supplies.

THE BANNER ELECTRIC CO., Youngstown, O.

THE BRILLIANT ELECTRIC CO., Cleveland, O.

BRYAN-MARSH COMPANY, Central Falls, R. I.—Chicago, Ill.

THE BUCKEYE ELECTRIC CO. Cleveland, O.

THE BUCKEYE ELECTRIC LAMP CO., City of Mexico

THE CLEVELAND MINIA. LAMP CO., Cleveland, O.

THE COLONIAL ELECTRIC CO., Warren, O.

THE COLUMBIA INC. LAMP CO. St. Louis, Mo.

ECONOMICAL ELECTRIC LAMP CO., New York City

THE FOSTORIA INC. LAMP CO., Fostoria, O.

THE GENERAL INC. LAMP CO., Cleveland, O.

THE JAEGER MINIA. LAMP MFG. CO., New York City

THE MONARCH INC. LAMP CO., Chicago, Ill.

MUNDER ELECTRIC COMPANY, Pawtucket, R. I.

NEW YORK & OHIO COMPANY, Warren, O.

THE SHELBY ELECTRIC CO., Shelby, O.

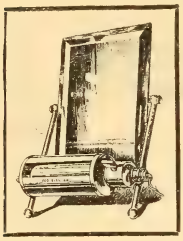
THE STANDARD ELECTRICAL MFG. CO., Warren, O.

THE STERLING ELECTRICAL MFG. CO., Warren, O.

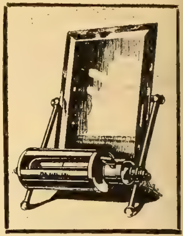
SUNBEAM INC. LAMP CO., Chicago, Ill.—New York City

THE SUNBEAM INC. LAMP CO., of Canada, Ltd., Toronto, Can.

THE WARREN ELECTRIC & SPECIALTY CO. Warren, O.



Most Men Shave By Artificial Light



In the morning before the day's work begins or at night when it is over.

The ordinary lighting fixture is placed with no reference to the needs of shaving.

Price
$3.75
Each

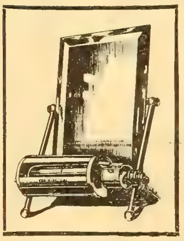
At
Any
Dealers

The Perfect Light for Shaving

Federal Electric Shaving Mirror

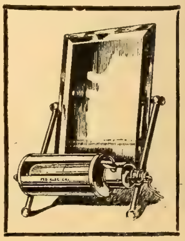
This mirror has an adjustable cylindrical reflector so placed that the light is cast upon the face and neck but not in the eyes. Shaving is made a quick and comfortable operation because you can see what you are doing.

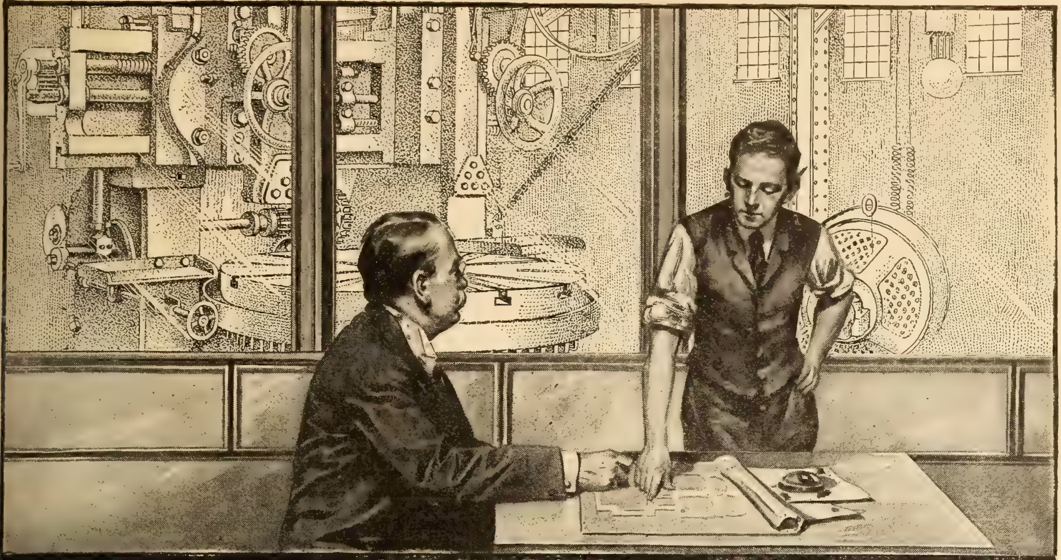
Each mirror has six feet of silk cord and plug for attaching to any light socket. It is so compact that it can be put in your suit case for traveling.



Write for our free booklet "Federalettes" describing many new and novel electric conveniences for the home

FEDERAL ELECTRIC COMPANY
MANUFACTURERS
Lake and Desplaines Streets, Chicago





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You will never gain a salary-raising ability by sitting still and thinking what you could do if you only had the other fellow's chance. You must **make** the chance by learning to do some one thing better than the other fellow. And the best way to do this is through the help of the I. C. S.—an institution that will make you an expert in the occupation of your own choice without requiring you to leave home, and without interfering with your regular work.

The trained man has the advantage every time.

As surely as the I. C. S. have raised the salaries of tens of thousands of others, they can raise your salary. It costs you nothing to find out how. Read the list of positions in the attached coupon, mark the one you like best, and mail the coupon to the I. C. S. Doing so places you under no obligation.

Send the coupon NOW.

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Please explain, without further obligation on my part, how I can qualify for a larger salary and advancement to the position, trade, or profession before which I have marked X.

- Electrical Engineering
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- R. R. Constructing
- Concrete Construction
- Architect
- Contracting & Building
- Architectural Draftsman
- Plumbing & Heating
- Chemist
- Bookkeeper
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City ______________ *State* ________

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¶ Advertisements in this section of Popular Electricity will cost 5 cents per word with 5% off for 3 times, 10% off for 6 times, 15% off for 9 times and 20% off for 12 times, cash with order.

¶ In order to secure the proper classification, advertisements must be in this office the first of each month preceding date of issue.

AERONAUTICS

MODEL AEROPLANE—INSTRUCTIVE TO experimenters. Self-propelled. Flies considerable distance. 50c prepaid. Agents wanted. AEROPLANE MFG. CO., 309 15th St., Brooklyn, N. Y.

BUILD AN AEROPLANE. SEND US $1.00 and we will send you blueprints and full directions for building a 3-ft. model Wright biplane or a 2-ft. model Bleriot monoplane. Both fly 200 feet by own power. Or blueprints and directions for a 20-ft. glider. Chicago Aeronautic Supply Co., Room 131, 5602 Drexel Ave., Chicago, Ill.

AGENTS

See what I say under "Typewriters." ATCHISON

AGENTS—SEE OUR AD UNDER "ELECTRIC Material." Weissgerber.

READ "PRINTING OUTFITS" ADV. C. P. & T. Co.

"PERFECTION POCKET ADDING MAchine—Lightning seller. Agents wanted. Cincinnati Specialty Mfg. Co., Dept. E, Cincinnati, Ohio.

AGENTS: EVERYONE; TO WEAR AND SELL our famous Bokara Diamonds. Write for free sample offer and catalogue. Northwestern Jewelry Co., 55 Northwestern Bldg., Chicago.

AGENTS WANTED—TO SELL TREES AND plants. Steady work. Highest commissions payable weekly. Clean straightforward proposition. Write for free outfit. Perry Nurseries, Rochester, New York.

LIVE AGENTS WANTED—TO SELL FINEST light on market. $1.00 profit on each. Business buy at sight. Send for free proposition. P. O. Box 2089, Bridgeport, Conn.

MAN AND BOYS; SCHOOL BOYS ARE EARNing $2.00 and $3.00 per day selling "Plantlife". We have the goods. YOU show it. IT sells itself. Sample and full particulars 10c (silver). Plantlife, 6614 Honore St., Chicago, Ill.

WIDOWS, LADIES, MEN. NEW, INTERESTing. Profitable, easy work. Spare time or permanent. Sell our useful specialties. Our original selling plan will double your sales. Particulars and $2.00 premium offer free. Fair Mfg. Co., FM 60, Racine, Wis.

IMPROVED KEROSENE MANTLE LAMP! 100 Candle-Power! ¼ coal-oil used! Best on American market! greatest campaign bargains ever offered! Get our prices! Establish business! Control territory! large profits! Webster Specialty Co., Waterbury, Conn.

LIVE AGENTS WANTED—HUSTLERS TO handle our 6 new catchy Xmas packages. Our "Baby Package" is a winner. Many are making as high as $20 per day. Big rush on. Start now with us and get in right for 1911. Write today for catalog of complete line including Xmas Specials. Davis Soap Co., 27 Union Park Ct., Chicago.

AGENTS

AGENTS—90 CENTS ON THE $1.00 PROFIT. Send 25 cents for sample and plan. Address S. E. James, Weisburg, Ind.

AGENTS: NEW BOOK. GREATEST BOnanza ever offered. Complete story of Aviation; conquest of the Air, by Wright Brothers, Curtis, Paulham, Brookins and others. How to build and sail an aeroplane. Hundreds of illustrations. Only $1.50. Best terms. Outfit free. J. S. Ziegler Co., Chicago.

AGENTS MAKE BIG MONEY SELLING OUR new gold letters for office windows, store fronts and glass signs. Any one can put them on. Write today for a free sample and full particulars. Metallic Sign Letter Co., 400 N. Clark St., Chicago, Ill.

SMALLEST ALARM CLOCK AND SMALLEST Bible in the world 10c each prepaid. Mahomet Alis Oriental dream book a wonderful volume correctly interpreting dreams, fortunes, lucky days and numbers, 25c prepaid. W. H. Garner, 119 South Lafayette St., Evansville, Ind.

AGENTS—THE BIGGEST MONEY MAKER ever known. The new Canchester Incandescent Kerosene Lamp revolutionizes old lighting methods. Burns air instead of money. Six times brighter than electricity, gas, or acetylene at one-tenth cost. Burns with or without mantle. Burner fits any lamp. Saves 75 per cent oil. No trimming wicks. Showing means selling. Territory going fast. Write today. Handsome outfit furnished. Canchester Light Co., Dept. P. E., 26 State St., Chicago.

$25 TO $40 A WEEK AT HOME OR TRAVELing. If you are making less than $25 to $40 a week, sit right down and write to the American Woolen Mills Co. for the most amazing money-making proposition of the age. This concern is the largest mail-order tailoring establishment in America, with immense capital and resources. They make the finest made-to-measure suits at prices that defy competition. Suits $7.50 and up. Pants $2.25 and up. All their vast business is done through agents. They start any ambitious man in the tailoring business, furnishing everything required, at their own expense. Men without any previous experience can make $25 to $40 a week, right from the start. Many of their salesmen make as high as $200 a week. The American Woolen Mills Co. produces its own cloth. This is the secret of the low prices its agents are able to offer on finest made-to-measure suits. With its own great tailoring shops, skilled tailors and finishers, it gives more style, better quality, greater value than any similar concern in existence. Best of all, it supplies its agents with handsome suits, at cost, and turns over to them all inquiries received from their territory. If any of our readers are looking for easy work, big pay and independence, we advise them to write to the American Woolen Mills Co., Dept. 496, Chicago, Ill., at once, for their wonderful proposition.

AUTOMOBILE SUPPLIES

DOES YOUR MOTOR KNOCK? YOU CAN locate the trouble in a moment with the Sonoscope. Used by motor experts all over the world. Price postpaid $2.00. Circular free. Gaylor Automatic Stropper Co., Stamford, Conn.

TRY TUERK'S NEW GASOLINE SAVING Carburetor. Soon saves its cost, runs lowest walking speed with power on high gear, and 3 to 90 miles instantly, smokeless, with perfect regularity, results guaranteed. Tuerk Carburetor, 3124 West Lake St., Chicago.

AUTO TIRES NEW FRESH CASES 28x3, $10.25; 30x3, $11.40; 30x3½, $14.40; 32x3½, $16.20; 34x3½, and 30x4, $17.50; 32x 4, $20.35; 33x4, $20.00; 34x4, $20.50. Send for complete price list. Send 10 per cent of the amount of your order and I ship, allow examination. Wm. Vanderpool. The largest tire dealer in the Central West, Jamestown, O.

BOOKS

STIX, STOCKTON, CAL.—BOOKMENDA, 10c.

SEE OUR AD UNDER "ELECTRIC MATERIAL." WEISSGERBER.

WANTED—ONE BOX OF SHORT CIRCUITS. See illustrated Add Display Section. G. Richardson.

MONEY-MAKING MAIL ORDER BOOKS: circulars furnished. MUTUAL EXCHANGE, Columbus, Ohio.

VENTRILOQUISM—EASILY LEARNED BY anyone. 64-page book containing complete instructions, 10 cts. A. W. Crosby, Merrimac, Mass.

WHITE SLAVE TRADE, EDITED BY ERNEST A. Bell, 500 pages, 30 illustrations, price $1.50 postpaid. Circular free. O. K. Pub. Co., Decatur, Ill.

TELEPHONE TROUBLES AND HOW TO find them, 1910 edition. Price, 25c. Hyde Pubs. Co., 183 5th St., Milwaukee, Wis.

BULLY BOOKS; "MAIDEN WIDOW," 25c. "Bailiff's Maid," 25c, illustrated. Catalogue for stamp. Ross Company, 373 Dearborn St., Chicago.

SEND 2c STAMP FOR OUR NEW ILLUSTRATED catalog of electrical books you should have, and particulars of our special offer, "An Electrical Library Free." Popular Electricity Book Department, Commercial Bldg., Chicago, Ill.

FOUR TWENTY-FIVE-CENT BOOKS FOR 50 cents. Gouge Work and Indented Woodwork, Wood-Carving for Beginners, Designing and Drawing. Dyes, Stains, Inks and Lacquers. Sampson Publishing Company, 1140 Beacon Bldg., Boston, Mass.

FOR FORTY CENTS WE WILL SEND OUR five excellent 10c books on Tempering Steel, Making and Fixing Electric Bells and Batteries, How to Grind and Set Edge Tools, How to Make an Annunciator, Small Electric Motor to be Built Without Castings, all practical and well illustrated. Sampson Publishing Company, 1140 Beacon Bldg., Boston, Mass.

BEST VALUE EVER OFFERED FOR 25c—Wireless Telegraphy Made Simple, by Victor H. Laughter. Including also "Wireless Telephone Receivers," "Construction of a Wireless Telephone Transformer," and "How to Make a Polarized Relay." In plain English—fully illustrated and with codes and diagrams. Edition limited—better order at once. Popular Electricity Book Department, Commercial Bldg., Chicago, Ill.

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READ "PRINTING OUTFITS" ADV. C. P. & T. Co.

A GOLD MINE. RENEW OLD BATTERIES in spare time. Send 25 cents for regular 100 formula. R. Scheffler, Rossville, Ind.

MAKE MONEY RENEWING DRY BATTERIES—See our ad under "Electric Material." Weissgerber.

3,000 SUCCESSFUL MONEY-MAKING FORMULAS and trade secrets. Many worth $1. Post-paid 50c. BEN E. NEWNHAM, WAUKEGAN, ILL.

$100 MONTHLY AND EXPENSES TO TRUSTworthy men and women to travel and distribute samples: big manufacturer. Steady work. S. Scheffer, Treas., MJ 174. Chicago.

I CAN START YOU IN A MAIL ORDER BUSINESS in your own home; conducted in your spare hours; big profits; everything furnished; valuable free booklet tells how. W. E. Foote, Box 254, Muskegon, Mich.

START PROFITABLE MAIL ORDER BUSINESS of your own, home evenings; money comes fast; easy work, small investment; booklet 10c.; particulars FREE. Advertising Company, P. O. Box 1615, New York.

100 MONEY MAKING FORMULAS, MAIL order ideas, salary raising kinks, etc., every month. Some say single copy worth $10.00. Trial 6 months' subscription only 10c. Mechanical Digest, Grand Rapids, Mich.

START AN EASY AND LUCRATIVE BUSINESS. We teach you how to establish a successful collection business and refer business to you. No capital required. Little competition. Rare opportunities. Write for Free Pointers today. Am. Collection Service, 428 State St., Detroit, Mich.

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YOU CAN MAKE FROM $200.00 TO $2,500.00 in addition to your regular salary under our new salary plan. Special opportunities for employees of electrical concerns, telephone, telegraph, light and power companies, etc. Particulars free on request. Circulation Department, Popular Electricity, Chicago, Ill.

WE START YOU IN A PERMANENT BUSINESS with us and furnish everything. We have new easy selling plans and seasonable leaders in the Mail Order line to keep our factories busy. No canvassing. Small capital. You pay us out of the business. Large profits. Spare time only required. Personal assistance. Write today for plans, positive proof and sworn statements. J. M. Pease Mfg. Co., 1185 Pease Bldg, Buffalo, N. Y.

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MOTION PICTURE MACHINES, FILM Views, Magic Lanterns, Slides, and similar Wonders For Sale. Catalogue Free. We also buy Magic Machines, Films, Slides, etc. Harbach & Co., 809 Filbert St., Philadelphia, Pa.

MAKE MIRRORS AT HOME. BIG PROFITS with little outlay. One 18x36 in. mirror, costs $2.00 to $5.00. You can silver a glass this size for 20c. Send $1.00 in stamps or money order and we will send you EXPLICIT DIRECTIONS how to do it; also how to emboss, grind, foil, gold leaf, frost chip, and make imitation stained glass. How to transfer photos on glass, bore holes in glass and cut skylights. George L. Patterson & Co., Dept. 4, Brooksville, Ky.

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STAMPS—200 ALL DIFFERENT, 10c—50 Austria, 50c.—30 Italy, 10c.—20 Japan, 10c.—30 Sweden, 10c. F. L. Toupal Co., Chicago Heights, Ill.

500 MIXED FOREIGN, CHILI, AFRICA, RUSSIA, Japan, etc., 25 cents. 1000 mixed old U. S. 25 cents. Stamps bought, list 4 cents. Kleinman Stamp Co., 3643 N. Marshall St., Philadelphia, Pa.

ELECTRIC MATERIAL

DRY BATTERIES RENEWED BY ANYONE. Complete guaranteed directions this month, 20c. Acme Publ. Co., Newburg, N. Y.

ATTENTION! RESPONSIBLE AGENTS IN every city to handle our "Hi-Life" Storage Batteries, best on the market. Write for prices and particulars. North-West Mfg. Co., 1247 N. Wells St., Chicago.

ANYONE CAN RENEW OLD DRY BATteries at very small cost with our method. Send 25c. and we will send you our complete $1.00 formula and instructions. Satisfaction guaranteed or money refunded. A. R. WEISSGERBER, 3455 North Hamilton, Chicago.

FOR SALE

READ "PRINTING OUTFITS" ADV. C. P. & T. Co.

FOR SALE—MOVING PICTURE FILM 1c. per foot. H. Davis, Watertown, Wis.

I BUY AND SELL ALL KINDS OF MANUFACturing machine shop equipments, dismantle whole plants. Fred. C. Dickow, 31 So. Desplaines St., Chicago.

TO CLOSE AN ESTATE WE WILL SELL jobbing foundry and Sleigh Business for $5,000 cash, balance any reasonable terms. Beach Brothers, Administrators, Millington, Mich.

FOR SALE, 15, 17½, 18 and 55 K. W., 120 VOLT, Generators. Also Rebuilt, Throttling, Automatic and Corliss Engines, Boilers, Pumps, Heaters and general machinery. The Randle Machinery Co., 1832 Powers St., Cincinnati, Ohio.

LUBRICANTS, ASBESTOS, GRAPHITE AND mica candles for loose pulleys and shaftings; no drip; no dirt; economical. Swain Lubricator Co., 250 E. Lake St., Chicago.

FOR SALE—COMPLETE SET OF CASTINGS, with blue prints of 3-4 h. p. gasoline stationary engine; includes governor and timer, screws, etc. $10. Comet Motor Works, 512 W. Monroe St., Chicago, Ill.

GAMES AND AMUSEMENTS

PLAYS, VAUDEVILLE SKETCHES, MONOlogues, Dialogues, Speakers' Minstrel Material, Jokes, Recitations, Tableaux, Drills, Musical Pieces, Entertainments, Make Up Goods. Large Catalog Free. T. S. Denison and Company, Dept. 26, Chicago.

INSTRUCTIONS

SEE OUR AD UNDER "ELECTRIC MATERIAL." WEISSGERBER.

WILL TEACH MECHANICAL DRAFTING for 25c a lesson. Box 625, Berwyn, Ill.

LEARN TO WRITE A LEGIBLE BUSINESS hand at your home, by correspondence; send for free booklet. Luther System, 33 Risley, Cicero, Ill.

BUILD A FOOT POWER WOOD-TURNING Lathe. Blue prints with complete instructions for 50c. Simple and practical. S. D. Willard, Redwood City, California.

BUILD YOUR OWN BATTERY. A COMplete 6-60 Storage Battery can be made by anyone using our Steel Case, Rubber Jar and best of grids and plates. Can be assembled in 30 minutes. Absolutely Guaranteed. Write for prices. A. N. S. Co., 225 Dearborn St., Chicago.

VALUABLE VOLUME—THOUSANDS OF FORmulas and trade secrets. Covers the widest scope in the most comprehensive manner. By far the best compendium of useful information ever published for all lines. It will add almost inconceivably to the value of your field of endeavor. For particulars, J. D. Chappell, Box 41, Westville, Conn.

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WE HAVE A LARGE COMPLETE MACHINE shop for manufacturing purposes and if you have an invention that you wish manufactured, send us your specification for our estimates. We will manufacture it for you. Rochester Manufacturing Company, Rochester, Mich.

$1.50 WILL BUY CASTINGS AND ALL MATErial for a neatly designed modern automatic steam engine. Engine has governor and slide valve on cut-off principle with adjustment for wear. Blue prints and instructions sheets 25c. PAT NOVELTY CO., Box 193, Elgin, Ill.

MISCELLANEOUS

See what I say under "Typewriters." ATCHISON

BLUE PRINTS FOR MODEL LOCOMOTIVE, full size, 50 cents. P. O. Box 74, Palestine, Tex.

READ "PRINTING OUTFITS" ADV. C. P. & T. Co.

WANTED—ONE BOX OF SHORT CIRCUITS. See illustrated Add Display Section. G. Richardson.

SCIENTIFIC TAILLESS KITE, 35 INCHES high, postpaid 20c. Percy Ewing, Decatur, Ill.

HOW TO READ MUSIC AT SIGHT. 50c. postpaid, or send for free descriptive booklet. Evans Co., 42 Peoples Bank, Wilkesbarre, Pa.

MAKE YOUR OWN FURNITURE, ONE-fourth cost. Full size patterns; complete directions. Send 10c. for Hall Seat pattern. Catalogue free. Home Furniture Pattern Company, 412 Potter Building, Birmingham, Ala.

MISCELLANEOUS

RENEW DRY BATTERIES—SEE WHAT WE say under "Electric Material." WEISSGERBER.

ACCOUNTS COLLECTED ANYWHERE—Fidelity Credit Co., 808 Clay, Richmond, Va.

"BOOMERANG" LABYRINTH PUZZLE—Delightfully enticing! Thirty-six labyrinths in one! Price 10c. Western Specialty Co., Sunnyvale, Calif.

SEBACKROSCOPE, MOST WONDERFUL INvention twentieth century. Bushels of fun. 20 cents. F. W. Jellison, 3133 Prairie Ave., Chicago, Ill.

PATTERN MAKERS.—10 BEST FORMULAS, etc. Postpaid, 25c. coin. B. Gregg, 717 Cincinnati St., Lafayette, Ind.

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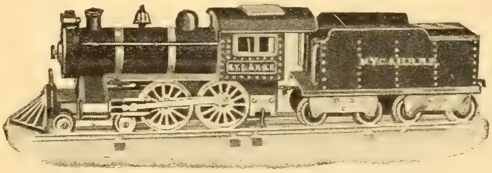

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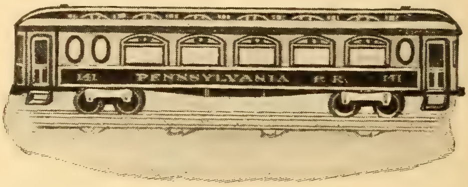

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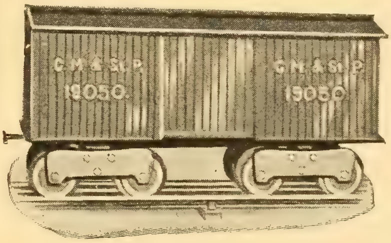

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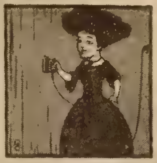

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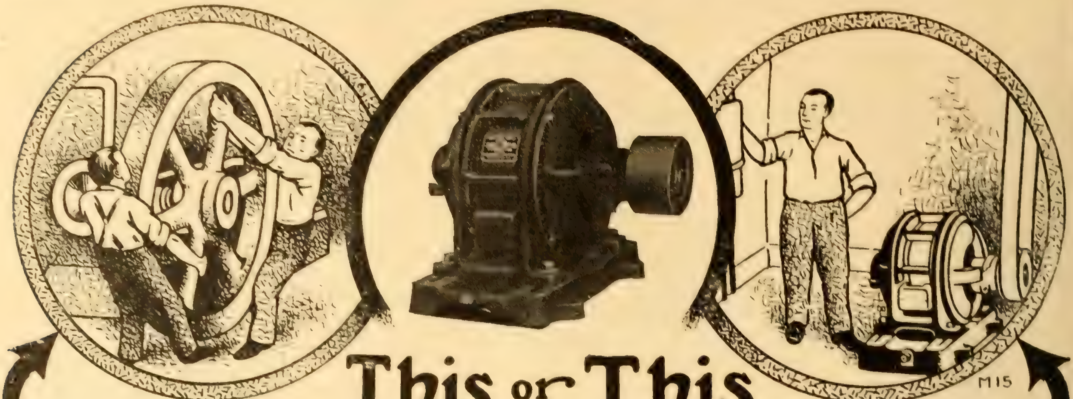

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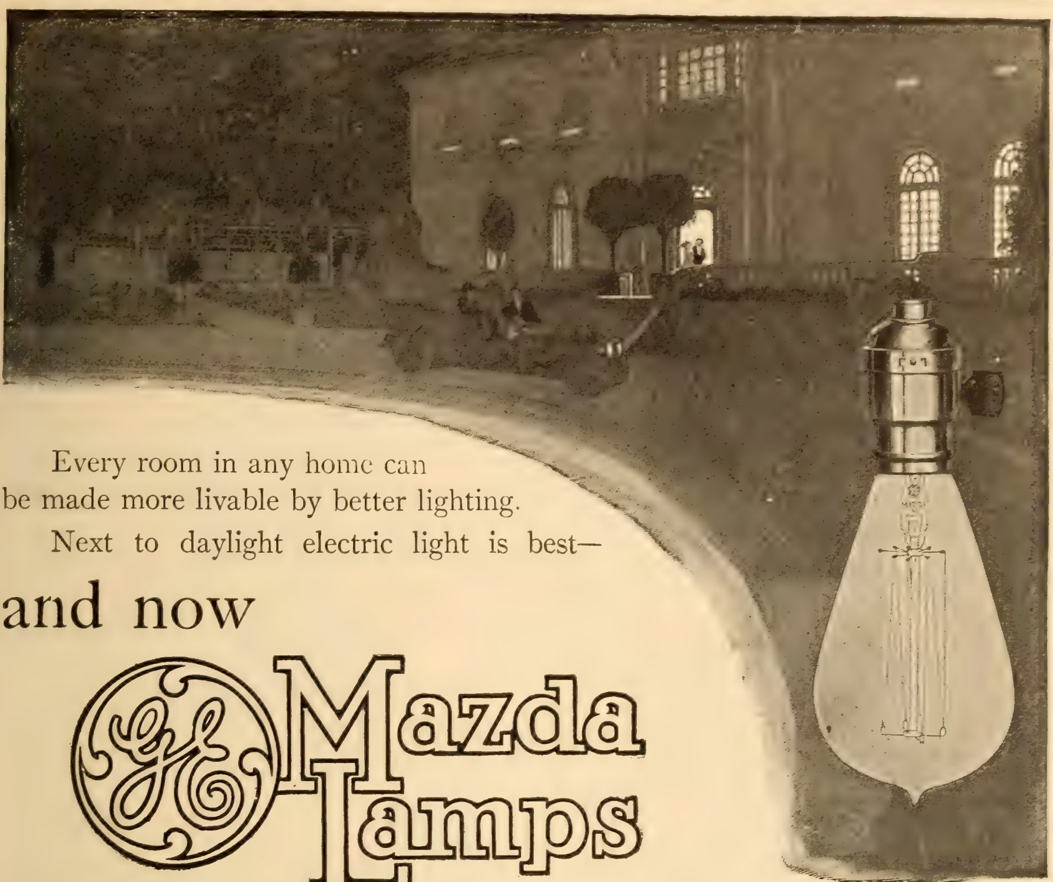

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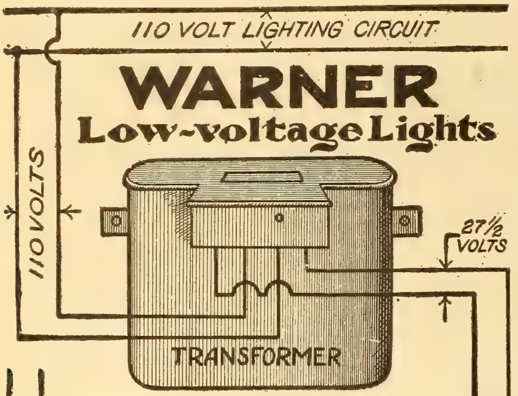

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¶ Tungsten lamps for the ordinary 110-volt lighting current are necessarily made with long, thin filaments which are frail and liable to break.

¶ A low-voltage tungsten lamp, like the Warner Mazda lamp, has a short, thick filament which will stand any amount of jarring.

¶ The Warner system permits the use of these **efficient and economical low-voltage tungstens** in homes, stores, hotels, offices, etc.

¶ It consists of a small transformer into which the 110-volt current is passed through one pair of taps and out of which current at 27½ volts is obtained from another pair of taps.

¶ This transformer, together with the Warner Mazda lamps constitutes all there is to the system.

¶ It is easily installed and means **plenty of clear, white light** at a much **reduced cost.**

¶ Send for our catalogue 600-P which tells all about it.

Warner Arc Lamp Co.

Wilton Junction, Ia.

Belden Magnet Wire

Our SILK and COTTON covered MAGNET WIRE is accurate to gauge with insulation of perfect uniformity and continuity and is put up one piece only per spool.

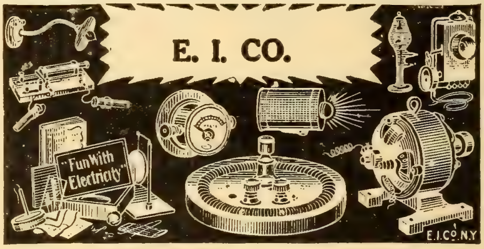
Beldenamel Magnet Wire is insulated with several layers of tough elastic enamel separately applied and baked on. It possesses the highest insulating strength and will not become brittle and flake off.

We quote the following net prices to readers of this paper and will ship postage or express prepaid on receipt of cash. **No orders filled amounting to less than $1.00.**

Prices are per pound.

Size	Single Cotton	Beldenamel	Single Silk	Double Cotton	Double Silk
16			.48		.61
17			.49		.62
18			.50		.64
19			.52		.65
20	.35	.48	.53	.38	.67
21	.36	.49	.54	.42	.69
22	.37	.51	.55	.44	.73
23	.39	.53	.58	.47	.77
24	.41	.56	.61	.50	.83
25	.44	.60	.66	.55	.89
26	.48	.66	.72	.60	.99
27	.52	.71	.78	.66	1.11
28	.55	.77	.84	.72	1.20
29	.59	.84	.92	.78	1.33
30	.65	.93	1 02	.85	1.54
31	.74	1.06	1.15	.92	1.85
32	.77	1.19	1.30	.98	2.04
33	.86	1.35	1.48	1.13	2.40
34	1.04	1.60	1.74	1.32	2.76
35	1.12	1.86	2.03	1.60	3.17
36	1.27	2.16	2.35	1.80	3.59
37	1.62	2.56	2.80	2.58	4.42
38	2.16	3.07	3.35	3.42	5.06
39	2.82	3.72	4.05	4.32	5.85
40	3.60	4.48	4.88	5.40	6.92

Belden Mfg. Co., 2306 S. Western Ave.
CHICAGO, ILL.

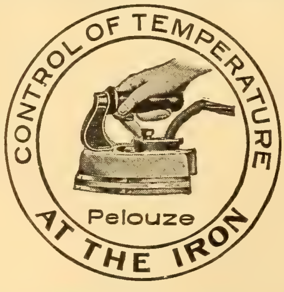

E. I. CO.
"Fun With Electricity"
E.I.Co. N.Y.

THE ELECTRO IMPORTING CO.

World's leader for electrical goods. "Everything for the experimenter." Send 2c. stamp for 128 page catalog.

233 (B) FULTON STREET . . NEW YORK

Pelouze Electric Iron


CONTROL OF TEMPERATURE AT THE IRON
Pelouze

Consumes less current than other irons

The only Electric Iron in which the current and temperature can be controlled at the iron.

The Iron that Guarantees Satisfaction.

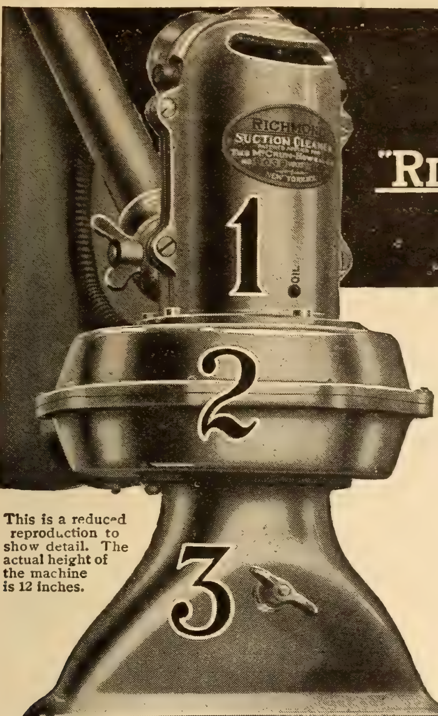
No Fire No Dirt No Odor

Every Iron Guaranteed

4lb.	6½lb.	9lb.	20lb.
$5.00	**$5.00**	**$7.00**	**$12.50**

For Sale by Leading Dealers

PELOUZE ELECTRIC HEATER CO.
232 East Ohio St., CHICAGO, ILL.



This is a reduced reproduction to show detail. The actual height of the machine is 12 inches.

One Dollar

Puts the "RICHMOND" Suction Cleaner in Your Home

ONE Dollar forever frees you from brooms, mops and dusters—and the backaches and drudgery they bring.

One Dollar forever stops the expense and the nuisance of Spring and Fall housecleaning.

One Dollar enables you to do, *easily*, by electricity, the *worst work* a woman has to do.

And One Dollar is the only cash outlay.

It will bring you the "RICHMOND" Suction Cleaner complete—ready for instant use.

The balance you pay for month by month out *of the actual money you save.*

For Vacuum Cleaning is the greatest of all household economies.

You are paying the price of a suction cleaner, *right now*—whether you have one or not.

You are paying its price out in twice-a-year house cleaning alone—for a "RICHMOND" makes housecleaning needless.

You are paying its price out—many times over—in the hard labor of sweeping and dusting which the "RICHMOND" makes unnecessary.

You are paying its price out again and again in the damage which dust does to your furniture, to your carpets, to your hangings, to your clothing—to YOU.

You are paying the price of a "RICHMOND" when a single dollar would save the waste.

YOU see here the lightest and simplest suction cleaner *ever designed.*

1—is the motor—not a "stock" motor, but one built expressly to operate the powerful suction fan to which it is directly connected, under

2.—a suction fan which embodies the best of all that was learned in two years of steady, scientific experiment.

3.—is the suction nozzle which is pushed over the surfaces to be cleaned - or to which can be attached a twelve-foot hose for high wall, drapery and upholstery cleaning.

The "RICHMOND" Suction Cleaner enables you, now for the first time, to clean by electricity without lugging a 60 to 80 pound machine from room to room—upstairs and down

It represents as great an advance over heavy weight vacuum cleaners as these cleaners represented over brooms and carpet sweepers.

But light weight and easy operation are but two ot the "RICHMOND'S" exclusive superiorities. There are many more.

The vibrating brush, which taps the caked dirt out of otherwise uncleanable rugs and carpets—the hair-drying and pillow-renovating attachments—the seven special tools which make the "RICHMOND" the most complete cleaner ever offered.

Manufactured exclusively for the RICHMOND SALES CO. by

THE McCRUM-HOWELL CO.

Park Ave. and 41st St., New York

Five Factories: Two at Uniontown, Pa.--One at Norwich, Conn. One at Racine, Wis.---One at Chicago, Ill.

MANUFACTURERS OF "RICHMOND" Boilers and Radiators' "RICHMOND" Enameled Ware, Bath Tubs, Sinks, Lavatories' "RICHMOND" Suds Makers, "RICHMOND" Concealed Transom Lifts, and "RICHMOND" Stationary Vacuum Cleaning Systems

Inquiries regarding built-in-the-house Vacuum Cleaning systems should be addressed to The McCrum-Howell Co., New York and Chicago.

Limited Offer

The Dollar Offer is limited. It is made to show our unbounded confidence in the "RICHMOND"

But by its very liberality, it is bound to swamp the factory. And when the limit of factory output is reached, the offer must be withdrawn.

So send the coupon today while the opportunity is still yours! Don't wait. Do it NOW.

THE RICHMOND SALES CO.
Dept. 49, 160 Broadway, New York

DOLLAR COUPON

THE RICHMOND SALES CO., Dept. 49, 160 Broadway, N. Y. City

I hereby order one "RICHMOND" Suction Cleaner, complete with the following attachments: 1 Hose Attachment Shoe; 1 12-ft. covered Suction Hose; 1 Book and Wall Brush; 1 10-in. Drapery Tool; 1 3-in. Suction Tool; 1 Felt-Faced Floor Tool; 1 Adjustable Wall Brush; 1 30-ft. Electrical Cord; 1 Complete Hair Drying Attachment—for which I agree to pay to your order, $1.00 herewith, and $6.00 on the first day of each of the next 12 consecutive months. Title to be given me when full amount is paid.

Name...

Address...

325,000 Escape Curse of Deafness

Little Invisible Sound Transmitter Does Wonders for the Deaf

Nearly half a million victims of Deafness have escaped from the Prison of Silence.

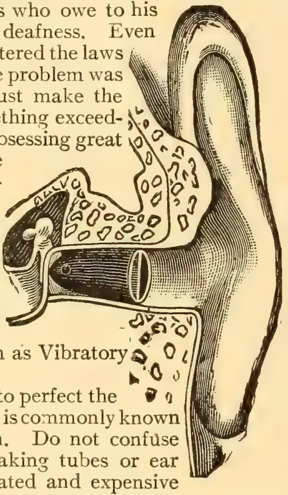
How did they do it?

By the use of a marvelous little Sound Transmitter, made of Vibratory Rubber.

Nobody but a deaf man would have had the infinite patience and dogged determination to study and experiment for years—to perfect the tiny Transmitter. That deaf man was Geo. H. Wilson.

Today he can hear as well as anyone, and is almost idolized by the thousands who owe to his genius their escape from deafness. Even after Mr. Wilson had mastered the laws of sound transmission, the problem was far from solved. He must make the Transmitter out of something exceedingly soft and light, yet posessing great vibratory power. The use of metal was impossible in so delicate a device. Ordinary rubber did not possess the necessary vibratory qualities. Mr. Wilson began experiments with rubber and finally succeeded in producing what is known as Vibratory Rubber.

This made it possible to perfect the Sound Transmitter which is commonly known as the Wilson Ear Drum. Do not confuse this device with the speaking tubes or ear trumpets, or the complicated and expensive portable telephones which make the wearer look conspicuous and feel ridiculous. The Wilson Sound Transmitter or ear drum is so small that it rests completely **out of sight** in the ear holes.



So soft and comfortable that the wearer forgets all about it. So magical in its results that it makes the deaf hear distinctly, **and instantly.** So many deaf people have written to Mr. Wilson for information in regard to the Sound Transmitter that he has written a little book about it. And just to make the story complete, he has put in several hundred letters from people of every station in life who are using his Sound Transmitters.

Copies of this facinatingly interesting book are now being mailed. If you wish one, simply write a post card immediately to the Wilson Ear Drum Co., 106 Todd Bldg., Louisville, Ky. (9)

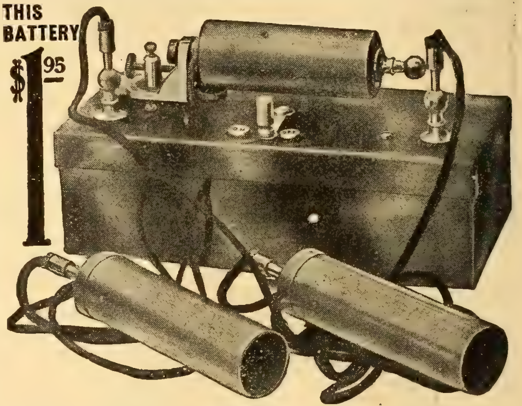
Autology Body and Brain Perfection

DR. MORAS has written a Commonsense Book on Autology, and by so doing placed the Standard of the Creed of Health Farther to the Front than any man who has lived for a thousand years—**Elbert Hubbard.** So you may see for yourself. Send for FREE "Guide to Autology." Address **E. R. MORAS, M. D., Dept. 12, Highland Park, Ill.**

"CURE YOURSELF BY ELECTRICITY"

New Book—Illustrated from Life—Sent FREE to all who write.

Write to-day for our new **Free Book—"Cure Yourself by Electricity"**—Illustrated with photos from life. Shows how the New Home Batteries cure **Rheumatism, Neuralgia, Lumbago, Headache, Insomnia, Constipation** and all nerve affections and diseases arising from sluggish circulation; also how they afford **electric baths and beauty massage without cost at home.**



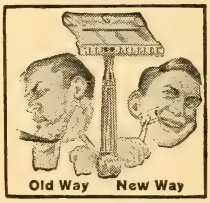
Every Home Should Have a Home Battery.

We send our batteries without a cent in advance (prices $1.95 and up) and allow **10 DAYS' FREE TRIAL.** Write for our Book.

DETROIT MEDICAL BATTERY CO.,
1199 Majestic Bldg., Detroit, Mich.

For Father, Son, Brother, Uncle, Nephew or Grandpa

$5.00 Safety Razor for Only 97 Cents



Beautiful silver plated, with stropper, handle and holder, a full set of Grains' Celebrated Wafer Blades, all in a handsome lined leather case, just like the high grade $5.00 outfits sold in stores. Remember this Special Advertising Offer is for a short time only in order to introduce in every city, town and hamlet in the United States.

All you need to do is to refer to this ad, enclosing **ninety-seven cents,** with your name and full address and the complete Grains' Safety Outfit exactly as described will be sent at once fully prepaid.

L. C. GRAINS COMPANY
184 Pulsifer Bldg. Chicago, Ill.

CHARCO-DENTO TOOTH PASTE AND TOOTH POWDER

TRADE MARK

are improvements in dentifrice making as they contain charcoal, a natural absorbent, which will take up and carry away the acids and decayed matter which destroy the teeth. CHARCO-DENTO has every ingredient necessary to clean, preserve and beautify teeth and heal and harden gums. Your druggist has it or can order it for you. Price 25c in paste or powder form. Send 10c for a month's supply and booklet. GOE & CO., 1 GOLANE BUILDING, RIDGEWOOD, N. J.

CHARCO-DENTO will remove tobacco and all other stains from the teeth

NEW INVENTION.

NO MORE WASH DAY!

NEW METHOD OF CLEANING CLOTHES

Cleans Family Wash in 30 to 50 Minutes—Woman's Hardest Work Made Easy—No Rubbing, No Motors, No Chemicals.

NOT A WASHING MACHINE

Does in One Operation the Work of Wash Board, Washing Machine and Wash Boiler.

SEE HOW SIMPLE—DIFFERENT, EASY. Put on any stove—add water, then soap, then clothes—**move knob occasionally.** In 5 to 8 minutes first batch clean—next batch same way, same water—in 30 to 50 minutes family wash clean. **No labor, no injury to clothes.**

Cleans woolens, flannels, blankets, or colored clothes, as well as white goods, finest laces, curtains, bed clothes. **Saves time, fuel, labor.**

EASY WAY in 30 to 50 minutes cleans washing which before took entire day. All metal, strong, durable, sanitary, light in weight. Easily used, cleaned, handled—always ready. Child or weakly woman can use it. Saves wash day drudgery.

Users Praise "Easy Way"

J. McGee, Tenn., writes:—"One young lady cleaned day's washing in one hour with Easy Way—another in 45 minutes." **Mrs. T. Bullen, Canada,** writes:—"I washed bedding, heavy quilts, curtains, etc., without rubbing." **Lauretta Mitchell, O.,** writes:—"Done a big washing in 45 minutes—sold 3 already." **A. D. Poppleton, N. Y.,** "Gives perfect satisfaction. Washed bed quilts, greasy overalls and fine clothes. Greatest thing on earth." **F. E. Post, Ga.,** writes:—

TWO WEEKS WASHING IN 45 MINUTES

Clothes cleaned without rubbing." **J. H. Barrett, Ark.,** after ordering 38 Easy Ways says:—"You have the grandest invention I ever heard of." **J. W. Myers, Ga.,** says:—"Find check for 12 Easy Ways. Greatest invention to womanhood, forever abolishing miserable wash day. **Sells itself.**"

AGENTS GETTING RICH

R. O. Brown, N. Y., placed 13 in 6 hours—(profit $39.00) **Mrs. J. Crown** sold 10 in 3 days—(profit $30.00.) **K. J. Blevins, O.,** writes: **"Made 7 calls, sold 5 one day,"**—(profit $15.00.) **R. H. Lattimore. Pa.,** writes: "Sold 4 this morning. Never yet turned down." **A. G. Witt, Pa.,** "Received Easy Way yesterday; sold 4 today—not out for orders." **Mrs. Gerrish, Mont.,** ordered sample, then one dozen, then 100—(profit over $300.00) **Just made one shipment 1000 Easy Ways** to Russian agent. **N. Boucher, Mass.,** orders 75 more, says: "Everybody wants one, best business I ever had." **A. S. Verritt, La.,** sold 8 in one day—(profit $24.00.) So it goes. **A Money Landslide.**

FREE SAMPLE TO ACTIVE AGENTS

We want managers, agents, men or women, home or traveling, all or part time, to show, take orders and appoint agents. **Easy Way new article,** not worked to death. Best seller out. Every family wants one. People glad to see it demonstrated; buy without being asked, and throw away costly washing machines to use it. **Only 2 sales a day means $36,00 a week profit. Price only $6.00.** Ready for use. Sent anywhere. Not sold in stores. **Order one for your own use. YOUR MONEY REFUNDED IF NOT SATISFACTORY.** Send for Free Sample offer, special agents' proposition. etc. **Costs nothing to investigate.** Send name and address anyway for full description. Write today.

HARRISON MFG. CO.
1473 Harrison Bldg., Cincinnati, Ohio.

Geisha Diamonds

THE LATEST SCIENTIFIC DISCOVERY

Bright, sparkling, beautiful. For brilliancy they equal the genuine, standing all tests and puzzle experts. One twentieth the expense. Sent free with privilege of examination. For particulars, prices, etc., address

THE R. GREGG MFG. & IMPT. CO.
Dept. 18, 517 W. Jackson Boul. CHICAGO, ILL.

3 Years to Pay For the Splendid

Meister Piano

Guaranteed for 10 Years

Price $175

30 DAYS FREE TRIAL

IN YOUR OWN HOME

No Cash Payments Down.
No Interest. No Extras.

WE PAY THE FREIGHT

Handsome Stool and Scarf free
$1 a Week. $5 a month.

Just to prove to you the splendid worth of this MEISTER piano let us send it to you on thirty days' free trial. It won't cost you a penny or a moment of bother. **First,** send for our beautifully illustrated MEISTER catalog and see how the Meister is made and the materials used in its construction. Read therein the testimony of delighted owners. Select the style you like and send in your order. We'll do the rest. The piano will be shipped to you promptly, freight prepaid, no matter where you live. Try it a month at our expense. You will be under no obligation **until you decide to buy.** Then you may take full advantage of our easy payment plan which makes it easy for any man of modest income to own this famous instrument. If you don't find it to be precisely as we have represented—then we'll take it back after the month's free trial and it hasn't cost you a cent.

SOLD DIRECT FROM FACTORY TO YOU—We deal only with the people direct and sell more pianos than any other firm in the world. We are sole makers of the MEISTER piano. It is produced in our own magnificently equipped factories and sold direct from the factory to you minus the usual profits of jobber, retailer and special salesman. There is only one small profit and that is ours. We were obliged to secure extra factory facilities this year because of an enormously increased demand and we are doing the finest work in the history of piano making.

WE WILL SEND THIS PIANO TO ANY HOME IN AMERICA ON A THIRTY DAYS FREE TRIAL, or any one of the other four styles some of which are very elaborate and beautiful. Send for the catalog today. **A post card will bring it.**

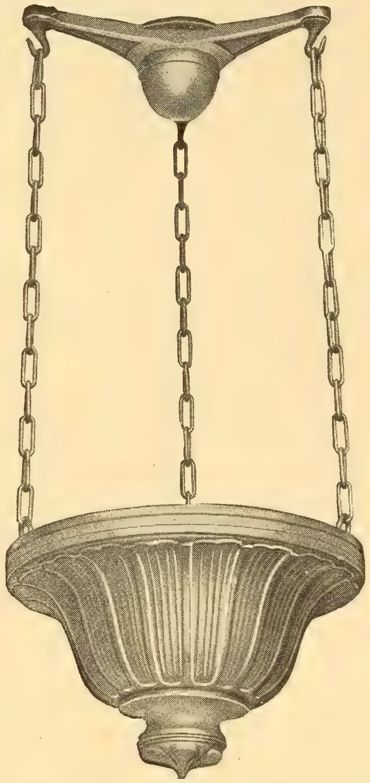
THE MEISTER PIANO COMPANY.
ROTHSCHILD & COMPANY, SOLE OWNERS
State, Van Buren and Wabash Ave. Dept 20 A, CHICAGO, ILL.

THE

EYE COMFORT

System of Indirect Illumination

The Great Success for Lighting Interiors



One of the notable recent successes in the lighting field is that of the **EYE COMFORT SYSTEM** of indirect illumination. By the use of this system it is possible to receive an even distribution of light which is reflected from the ceiling. This source of light is entirely out of view; as a result the eyes are protected from the intensity of illuminant.

Thousands of these installations are being made in residences, offices, hotels, restaurants, churches, clubs, hospitals, etc., etc.

Illuminating Engineering Advice Free

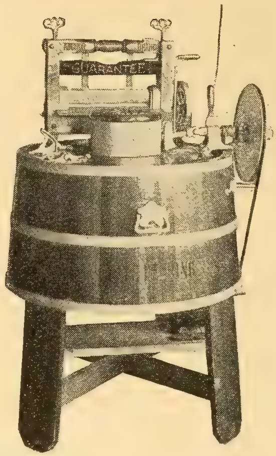
Write our Engineering Department your difficulties about your lighting problems and they will solve them free of cost.

We Sell Through the Electrical Trade Only

If your dealer does not handle, send to us for booklets and full information.

Lighting units of sufficient efficiency to make Indirect Illumination a success, are only possible by combining with the Mazda (tungsten lamps) the reflectors of greatest efficiency, especially designed for the purpose by the

NATIONAL X-RAY REFLECTOR CO.
257 Jackson Boulevard **CHICAGO**



The Perfect Electric Washer

Built to Wash the Woman's Way

Investigation of the Perfect Electric Washing Machine will show that it is the ultimate result of five years experimenting. Every fault that has accompanied all other electric machines of this kind has been eliminated. This machine is absolutely safe, all mechanical parts being enclosed. Its mechanical construction is such that the greatest amount of work is secured from the lowest cost of operation. It is durable, practical and superior to all other washing machines in ease of operation. The gearing used is simple and unique as well as noiseless. The lid can be raised at any time without turning off the power—simply moving a clutch. It is not necessary to stop the machine. **Wringer attachment is entirely new and the smallest articles of clothing can and will not wrap around the rollers.**

GAS ENGINE WASHER

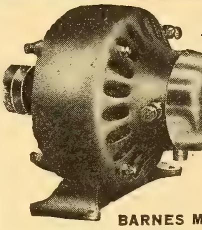
We also furnish gas engine attachment for customers not having current available.

DEALERS, CENTRAL STATIONS AND JOBBERS write immediately for our prices.

THOMPSON BROS.
815 Second Nat'l Bank Bldg. **Cincinnati, O.**

$\frac{1}{12}$ AND $\frac{1}{8}$ Direct and Alternating Current Motors

VARIABLE SPEED - SINGLE PHASE



MOTORS THAT WILL ABSOLUTELY NOT HEAT

"The Barnes Motors" are especially adapted for Washing Machines, Vacuum Cleaners, Air Purifiers, Ventilating Devices, Coffee Mills, Meat Choppers, Printing Presses, etc., etc. —Dental and Medical work a specialty. Positively the best motor for use where motor driven work is necessary —greatest power, highest efficiency. We want Reliable Agents everywhere —write at once for prices and catalog. Let us figure on your requirements.

BARNES MFG. CO., SUSQUEHANNA, PA.

VICTOR ELECTRIC CO.

Manufacturers of

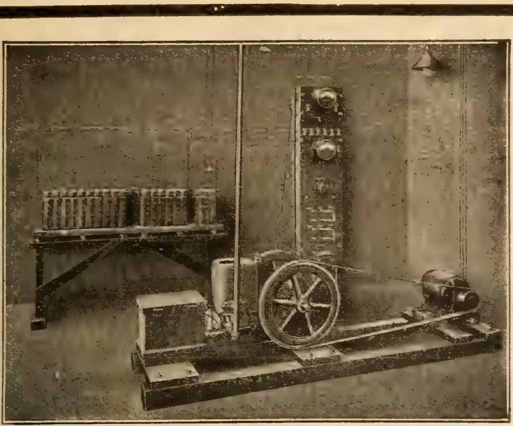
APPARATUS ELECTROTHERAPEUTICAL

Our line includes the highest quality of

X-Ray Apparatus	**High Frequency Apparatus**
Therapeutic Lamps	**Sinusoidal Apparatus**
Giant Eye Magnets	**Diagnostic Lamps**
Wall Plates	**Air Compressors**
Cautery Transformers	**Bone Surgery Outfits**
Electric Sterilizers	**Vibrators**
Air Heaters	**Faradic Coils**

Correspondence of Physicians and Surgeons and Hospitals solicited.

55-61 Market Street, CHICAGO



Electric Plants
for
Farms, Hotels, Factories, Etc.

Every suburban home, farm, factory, hotel, etc., not reached by a public lighting station can now have, at a small expense, all the advantages of electricity which are enjoyed by city inhabitants.

This Company has designed small electric lighting plants, that are inexpensive, require small space, can be set up and operated by anyone and give an absolutely dependable and continuous service—day or night. Plants are furnished for

$400 and Upwards

A complete plant consists of a small Gas Engine, Dynamo, Storage Battery and Switchboard. It is only necessary to run the engine a few hours occasionally to charge the battery; the battery furnishing current at all other times. Small motors for various industrial and household purposes can also be operated with these plants.

The storage battery used is the "**Chloride Accumulator**". This battery is exactly the same type of battery as is used by the large electric lighting companies, railways, telephone and telegraph companies, etc.

If you are interested, write our nearest sales office for our book ***"How to Have Your Own Electric Lighting Plant,"*** state the number of lights you wish to install, and let us show you how easily and cheaply you can have an electric lighting plant. If you are an electrical dealer, send for our special dealers proposition.

THE ELECTRIC STORAGE BATTERY CO.

1889 PHILADELPHIA, PA. 1910

New York Boston Chicago St. Louis Cleveland Atlanta Denver Detroit San Francisco Toronto

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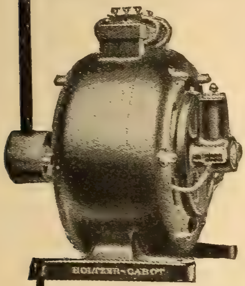
Motors for all Purposes—1-20 to 1-2 H. P. Single Phase



Holtzer-Cabot Motors are made for all kinds of purposes—washing machines, vacuum cleaners, adding machines, ozone machines. Any mechanical appliance requiring motors from 1-20 to 1-2 H. P. are absolutely perfect when carrying

Holtzer-Cabot Motors

We make a specialty of single phase alternating current motors and build them from manufacturers' designs and on specifications.

Absolutely perfect in workmanship and electrical design.

We will send you our catalogue 330-D immediately for the asking.

THE HOLTZER-CABOT ELECTRIC CO.

621 Albany St., Boston, Mass. 6161-65 S. State St., Chicago, Ill.

Only RELIABLE AGENTS
WANTED TO SELL THE
"Bee" Suction Cleaner

Because we claim only the TRUTH. Price, complete with all attachments, **$60.00.** Weight, only 20 lbs. No jar or vibration. Runs on either current without adjustment. Best work with the least effort and guaranteed.

BEE SALES COMPANY, 12-14 S. Clinton St., CHICAGO, U. S. A.

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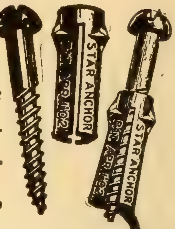
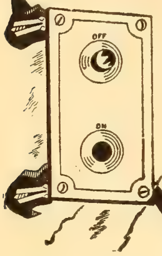


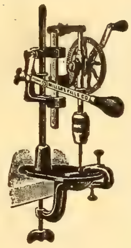


If you will simply send us your name and address, we will mail some samples of the Star Screw Anchor free of all cost to you. We want you to know the advantages of this wonderful time, labor and cost saving device for attaching electrical and other fixtures to walls of tile, brick, stone, etc., and name of dealer in your city from whom they may be purchased.

A POSTAL RIGHT NOW

STAR EXPANSION BOLT CO.
Catalogue Dept. 10, 147 Cedar St., NEW YORK

Our Drill Press No. 23



will be found an exceedingly useful and convenient tool for light work. The frame is made of steel and iron japanned. The feed is supplied by a compound lever, which is convenient, sensitive and effective. The chuck holds drills from 0 to $\frac{3}{8}$ of an inch. The distance from chuck to table with sliding frame at highest point is $6\frac{1}{2}$ inches Weight $8\frac{1}{2}$ pounds. Price each $3.50..

ASK FOR CATALOGUE

Millers Falls Co., 28 Warren St., New York, N. Y.
(5)

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Klein Tools

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Send 3 cts. in stamps for Mailing Catalog.

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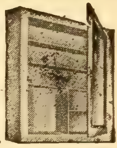

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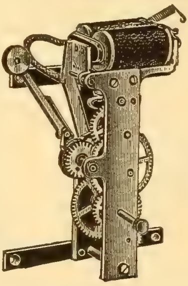

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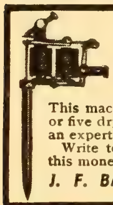

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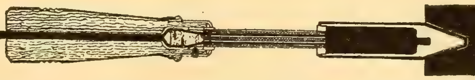

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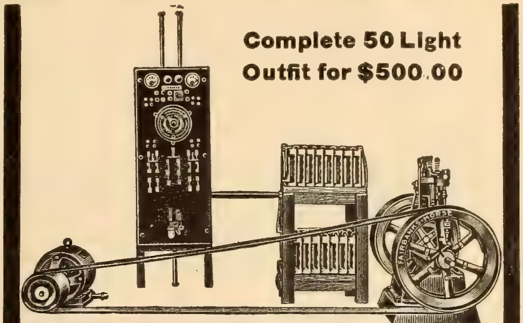

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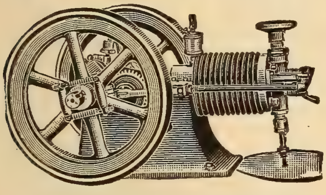

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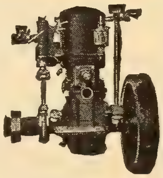

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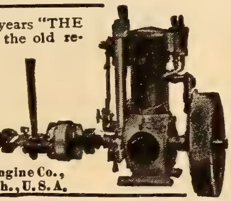

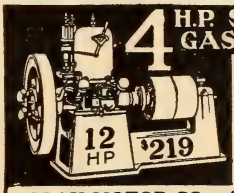

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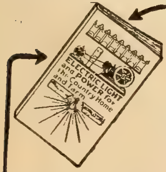
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Do You Want Electric Light or Power for Your Country Home or Farm?

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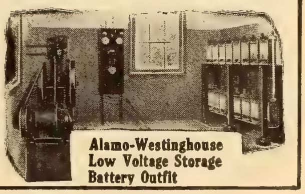

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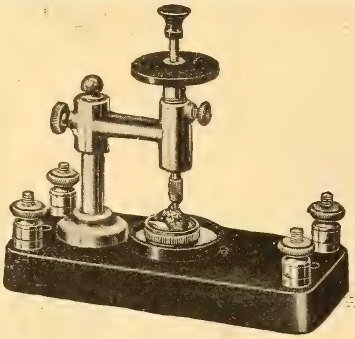

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is that without a good detector, wireless is a failure. We offer to experimenters

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protected by patent and positively the best manufactured. You *need* the guaranteed, genuine silicon.

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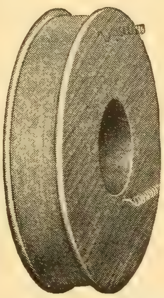

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Our Secondary "UNITS" are wood spool sections wound, parafined, etc., and all ready to connect up. You can buy a spool at a time or as many as you want, and they will cost you but little more than the wire alone,

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MANUFACTURERS: We have an attractive contract proposal to offer covering your requirements for 12 months.

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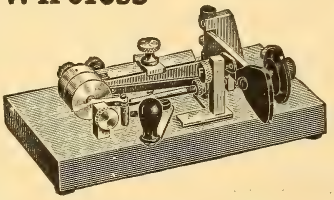
Superb for Wireless



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More MECOGRAPHS are in use than all other automatic transmitters combined.

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Over 60 percent more movements required to send on a Morse key than on a MECOGRAPH.

Holds best records for speed and long distance sending.

All expert telegraphers and all bonus men use sending machines.

Operators everywhere are improving their efficiency by adopting the use of the MECOGRAPH. Fall in line now. Eliminates glass arm.

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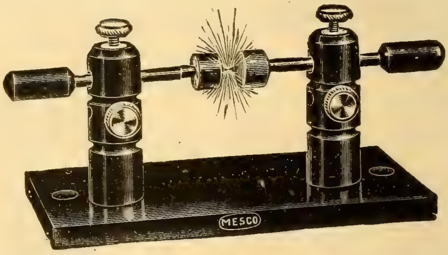
WIRELESS TELEGRAPHY



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Catalogue No 24B 180 pages of general electrical supplies mailed on request.

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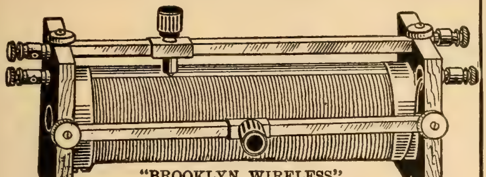

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PERMANENT MAGNETS
MADE TO ORDER
Tungsten or Manganese Steel

Write for quotations sending drawing and specifying quantity wanted.

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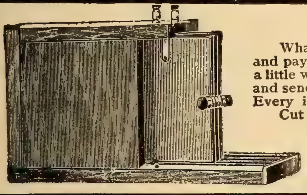

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What kind of wireless apparatus are you buying? Are you allowing yourself to be tempted by low prices and paying good money for goods which are not worth the express charges you pay on them? Perhaps you are a little wiser and are paying the highest prices so as to be sure not to be "buncoed." Why not strike a medium and send for our catalogue showing a line of goods which are of the **RIGHT** price and even **BETTER** quality. Every instrument sent out by us is backed by our guarantee to give **PERFECT SATISFACTION.**

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Our Wireless Goods are the best on the market, and are guaranteed to *work*. Our instruments are made of the finest materials, and are sold at present at a price within the reach of every experimenter. Send 2c stamp for our large catalogue which contains a full list of Wireless Instruments, Novelties and Electrical Goods, and also a great deal of Wireless information for the Wireless experimenter.

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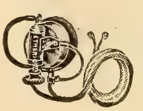
NEW WIRELESS WONDER



Aero-Field Receiving Outfit. Weight only 4 oz. Receives up to 75 miles. The Wireless Sensation of the year. Consists of 1000 Ohm, receiver and attachments all assembled on regular size leather insulated head band. Price $4.00 (not including light field aerial). A wonderful instrument at a wonderful price. Boy scouts and all requiring light outfits send 2c for description of the Aero and catalogue. **Etheric Electric Co.,** Salesrooms and Factories, 278 Lenox Ave., cor. 124th St., 71 Barclay St., New York, N. Y.

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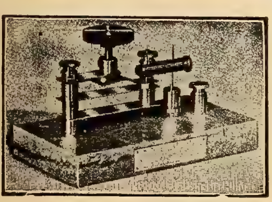

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Send 4c stamp for our New Big 200-page Catalogue.

Twenty large sections of wireless and electrical goods.

This catalogue contains 70 pages of wireless instruments for private and commercial installation and for the experimenter.

Our $19.00 receiving outfit which includes the celebrated Ferron Detector, No. 6057 Tuning Coil, wound with bare copper wire, and by a special method protected by patent, Tubular Condenser and 2000 ohm Western Electric head set—has a proven, demonstrated range exceeding 700 miles. Unquestionably the finest wireless set before the public for the price.

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Electrical Experimental Outfit for $5.00

With blue prints, instruction sheets and all goods mentioned in the coupon

1. Generator-weight five pounds, has bronze bearings, brass gear drive, silk wound armature and handle.
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14. Two Small Lamps.
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16. Three Lamp Sockets.
17. Material for making bell transformer.
18. Raw material such as sheets fibre, brass tube, rod and sheet, rubber, contacts, and shellac, mica and tin foil.
19. Three stamped envelopes addressed to our instructor.
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Free Auto Transformer

CUT OUT THIS COUPON and send it with your order and we will send you free, a 250-page electrical instruction book, six blue prints of things you can do with our outfit, and an unassembled auto transformer. Send order ***NOW.***

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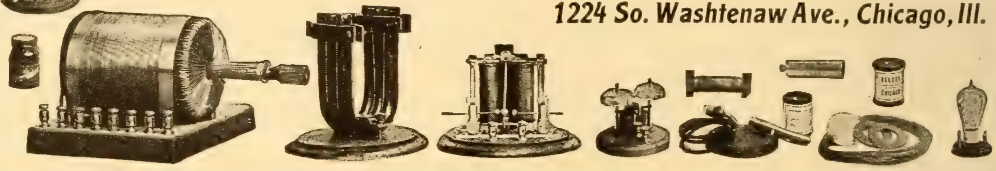
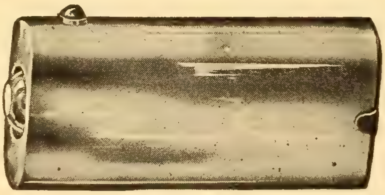


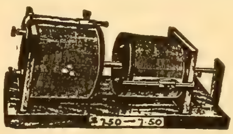
SPECIAL



$1.00

The Famous Pocket two-cell Esram Tungsten Lamp complete, postpaid to any address for the small sum of **$1.00.** Three-cell Tungsten Lamps, postpaid for **35 cents.** Three-cell Esram Tungsten Lamp, postpaid for **35 cents.** Complete Pocket Lamp, postpaid for **45 cents.** 4 1-2 Volt Lamp and Socket, postpaid for **25 cents.** We can save you money on all the wireless telegraph and electrieal supplies. Send for **Our Free Catalogue.**

The Famous $15.00 Transformer for **$8.00.** Get it and compare with any other that your friends may have. A double pole, single throw switch, porcelain base, regular price 35 cents, this month, postpaid for **25 cts.** Our Double Pole Wireless Receivers, special this month, complete with head-band and cord, postpaid, for **$4.00. We allow 10 per cent discount** on our catalogue price on all goods bought before December 1st, 1910. We want to show you our goods and the promptness of shipping orders. **Take the advantage of the 10 per cent discount, We urge you.** Money **refunded** if you are not satisfied with the goods.



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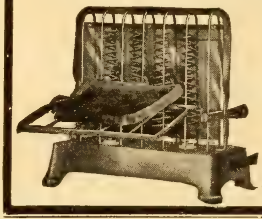
Electric Toaster

Attach to any Electric Lamp socket and use it on the table.

Toasts one slice of bread per minute. Costs 1-12 of a cent per slice. Handsome and durable.



Brings comfort into your home. Always have fresh hot toast. Complete with attaching cord and plug $2.75 express prepaid.

ELECTRIC
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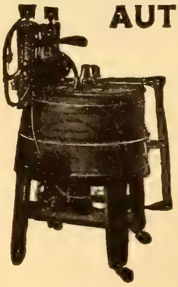
AUTOMATIC ELECTRIC WASHER



Is the simplest machine to operate you can possibly imagine, as all parts are very accessible.

We guarantee this machine to be the most substantial in construction, and by far the most convenient for its user.

Send to day for our booklet of information.

Automatic Electric Washer Co., - Newton, Ia.

30653

A Live Boy's Choice for Christmas

THORDARSON'S TOY TRANSFORMERS

Attach to any alternating current lamp socket and have a miniature Power Plant of your own. Operates any class of electrical toys, rings bells, lights small lamps and does any of the dozens of things you want to do. **Indestructible.** Besides the fun you get you learn the fundamental working principles of electricity—no more battery trouble. Show this to your father.

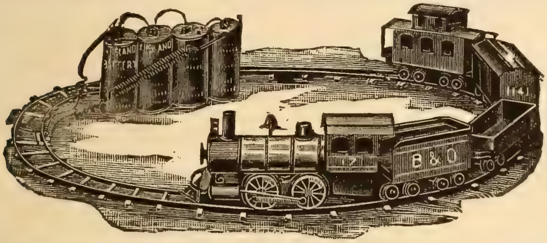
Write us for descriptive circular

Thordarson Electric Mfg. Company

220 So. Jefferson St., Chicago

ELECTRICAL TOYS FOR BOYS

SOME CHRISTMAS SUGGESTIONS { **SCIENTIFIC ELECTRICAL NOVELTIES**
Practical, Complete, Durable, Harmless



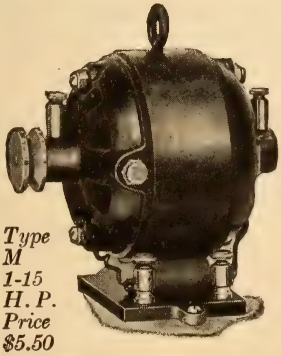
EVERY boy in the country can easily *own* a railroad. Costs little and pays big dividends in fun. Our Models of Locomotives, Trains, Trolley Cars, Dynamos, Lamps, etc. are practicable and durable inventions. Equipped with dry batteries, no acids or liquids used, perfectly safe and harmless. Electrical toys instruct as well as amuse.

Catalog B, fully illustrated, quoting low prices—SENT FREE.

THE CARLISLE & FINCH CO.

264 E. Clifton Ave., Cincinnati, Ohio

Largest Manufacturers Electrical Novelties in the World.



Type M 1-15 H. P. Price $5.50

New Toy Motors For Boys

WITH ALL THE LATEST IMPROVEMENTS

WOUND FOR 110 VOLTS BOTH ALTERNATING AND DIRECT CURRENT

No more trouble or expense with batteries. Simply use an attachment cord connected to any lamp socket. The best motors made for operating mechanical toys, models, advertising devices, 8-inch fan blades, etc. No boy's experimental laboratory complete without one of these motors. *Exact reproductions of large commercial motors* beautifully finished in black enamel; brass parts polished.

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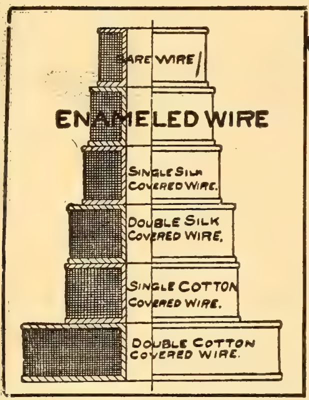
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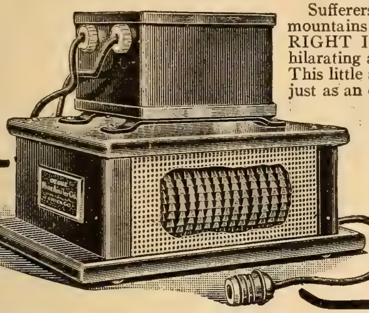

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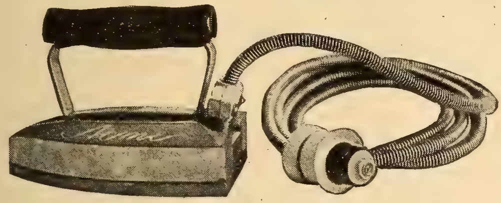

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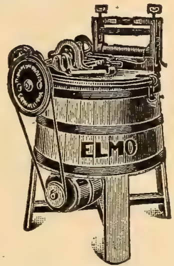

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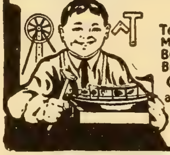

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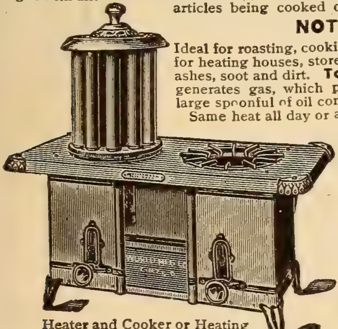

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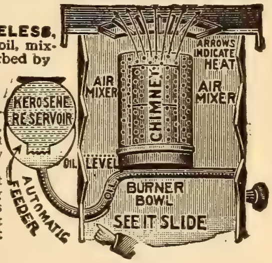

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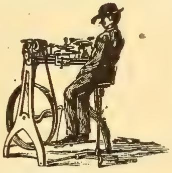

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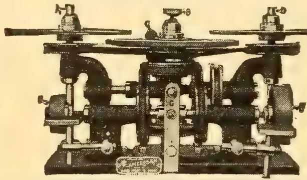

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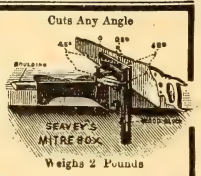

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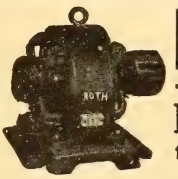

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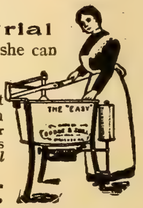

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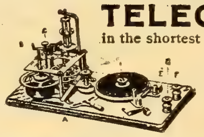

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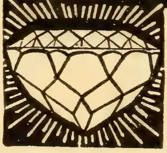

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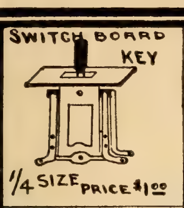

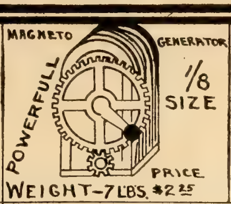

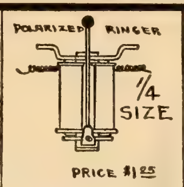

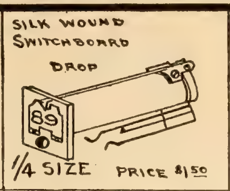

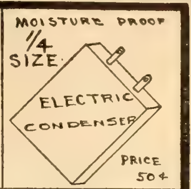

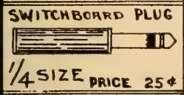

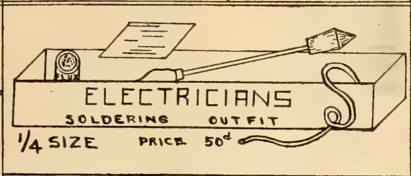

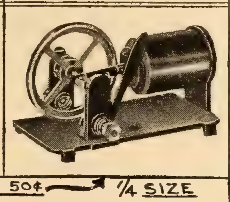

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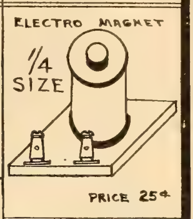

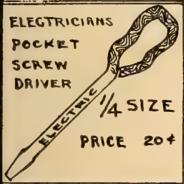

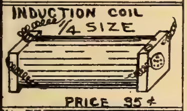

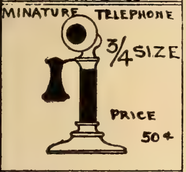

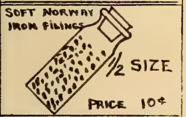

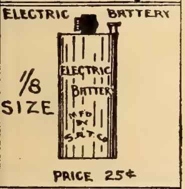

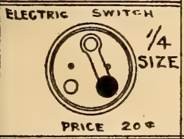

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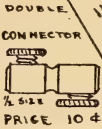

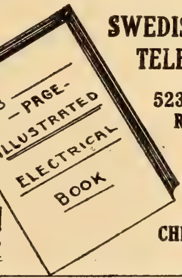

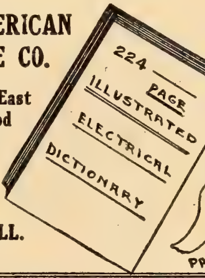

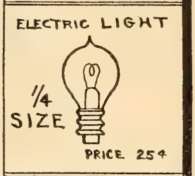

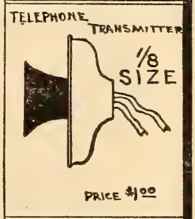

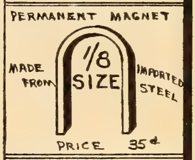

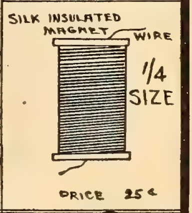

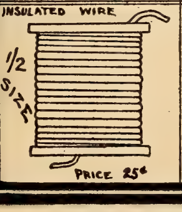

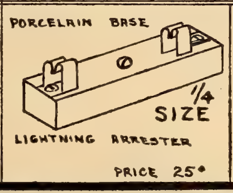

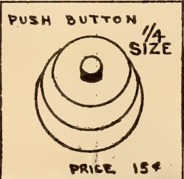

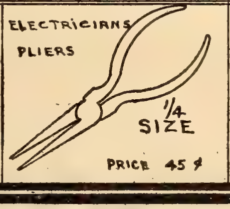

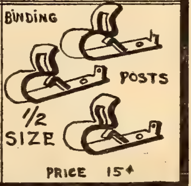

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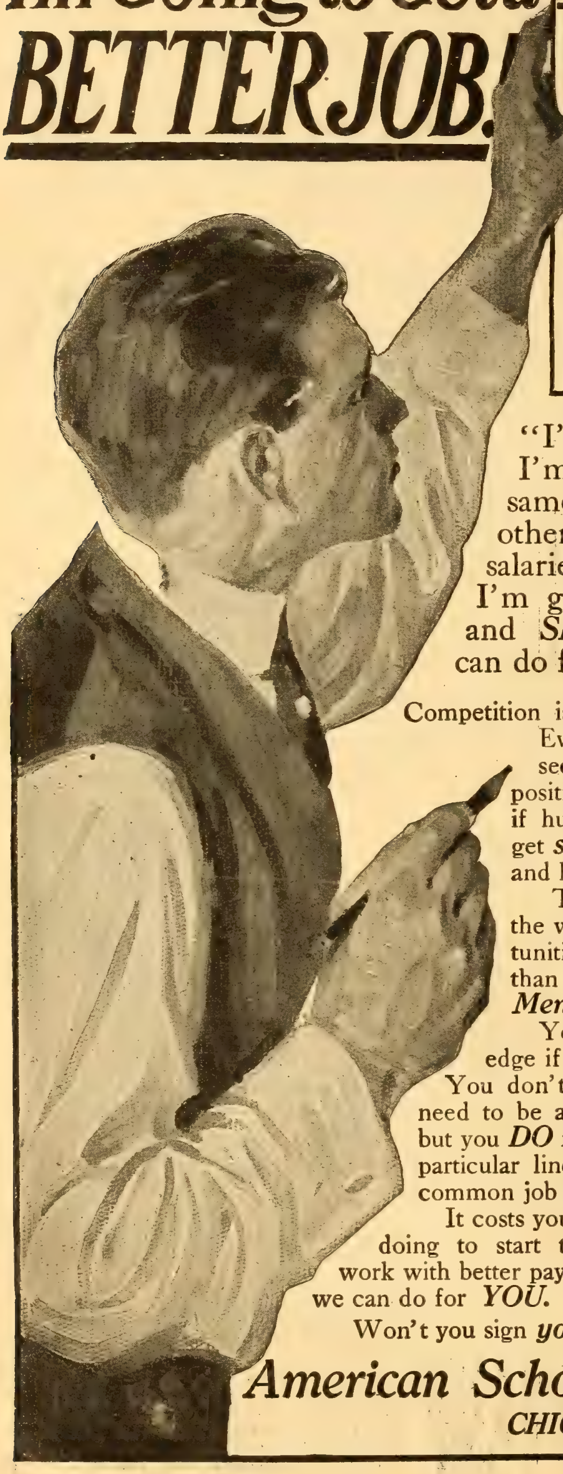

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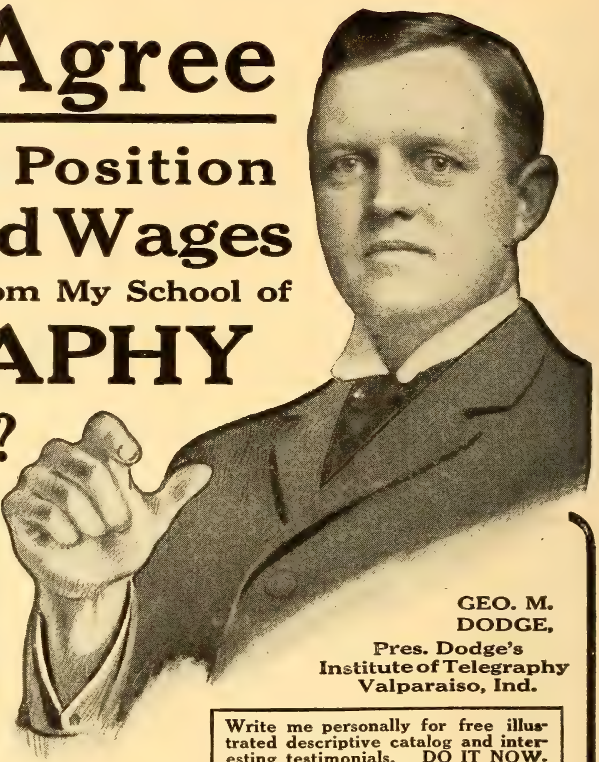

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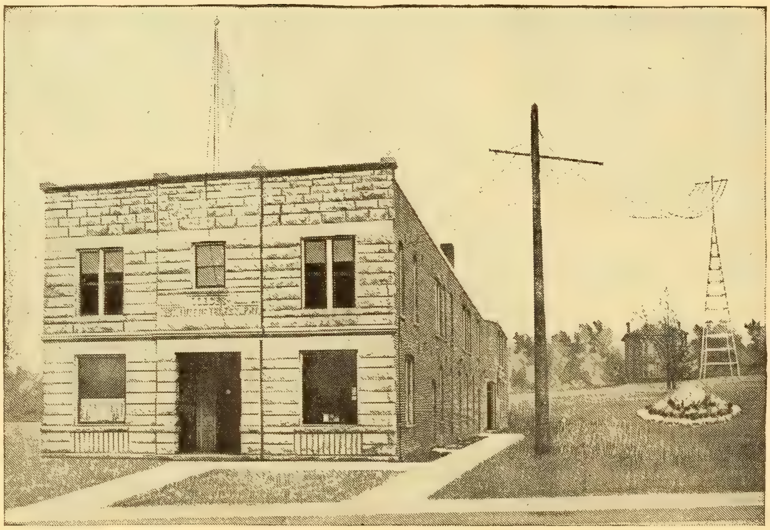

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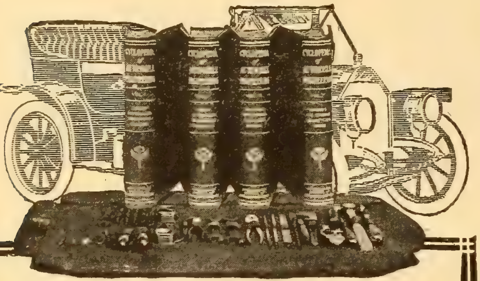

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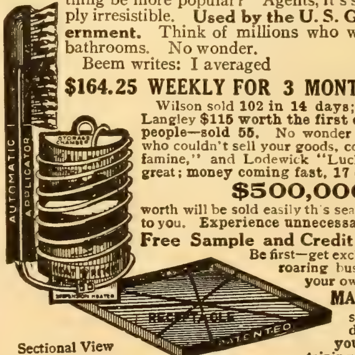

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ABOUT REMEMBERING

By
ELBERT HUBBARD

Henry Dickson

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For some long time I have been promising myself to write up my good friend, Mr. Henry Dickson, of Chicago, and I have not forgotten. ¶ Mr. Dickson is teaching a Science or System, whichever you choose to call it, which I believe is of more importance than the entire curriculum of your modern college. Mr. Dickson teaches memory. Good memory is necessary to all achievements.

¶ I know a man who is fifty-five years old. He is a student. He is a graduate of three colleges, and he carries more letters after his name than I care to mention. But this man is neither bright, witty, clever, interesting, learned nor profound. He's a dunce.

And the reason is that he CAN NOT REMEMBER. Without his notes and his reference literature, he is helpless.

This man openly confesses that he cannot memorize a date or a line of poetry, and retain it for twenty-four hours. His mind is a sieve through which sinks to nowhere the stuff he pours in at the top. Education is only what you remember. The lessons that you study into the night and babble about the next day in class are rot, unless you retain them and assimilate them by the slower process of memory. You cannot gulp and discharge your facts and hope they will do you any good. Memory only makes them valuable.

Every little while in business I come across a man who has a memory, a TRAINED MEMORY, and he is a joy to my soul. He can tell you when, where, why, how much, what for, in what year, and what the paper said the next morning.

Like this man is another, the general manager of a great corporation in a Western City. He never misses a face. If he sees you once, that's enough. The next time he'll call you by name, inquire about the folks at home and ask if you have recovered from that touch of rheumatism.

He told me how he did it. He told me that he studied memory-training with Professor Dickson of Chicago. Also, he said a lot of nice things about Professor Dickson, that I hesitate to write down here lest my good friend Dickson object.

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To the man or woman whose memory plays you tricks, I especially recommend that you write to Professor Dickson to send you his literature. It will cost you nothing, and if his credentials and recommendations and the facts he sets forth, do not convince you, you are not to be convinced—that's all. You do not know when you will be called to stand on your feet and tell what you know: then and there a trained memory would help you.

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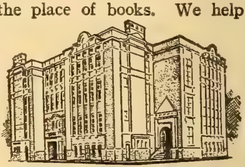

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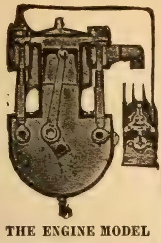

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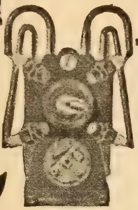

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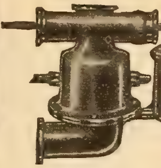

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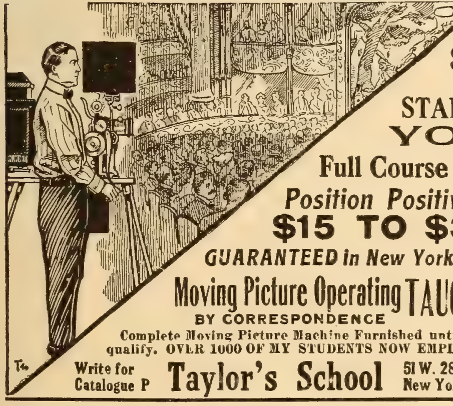

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All this is very good and very essential, but where is the man? You haven't begun to find "all of him." Neither can your jobber or your retailer find "all of him," not without the aid of the last and most essential of all the aids that you can command—the class publication.

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Now where were the trade papers, the jobber and the retailer? On their respective jobs, every one of them and doing good work. But the job of telling the American public about things is too big for all three of them combined.

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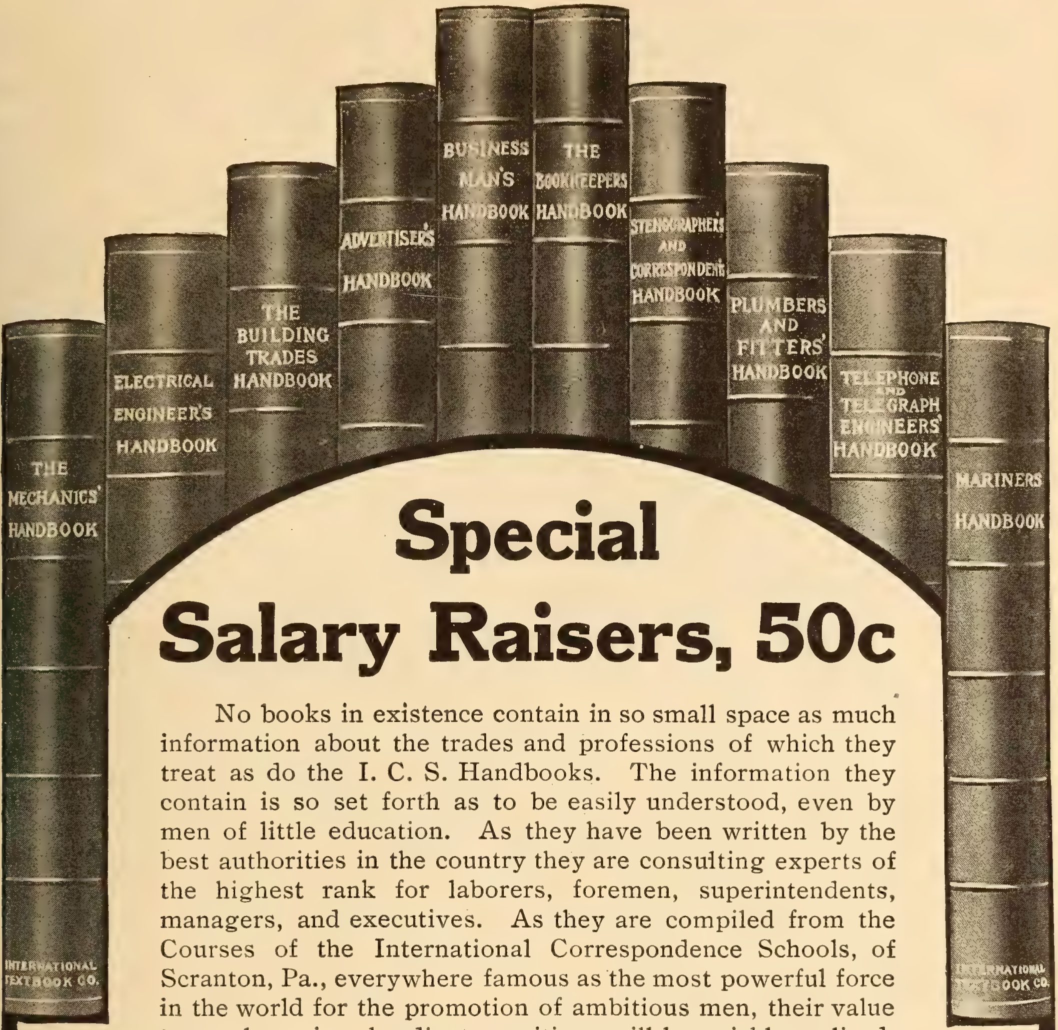
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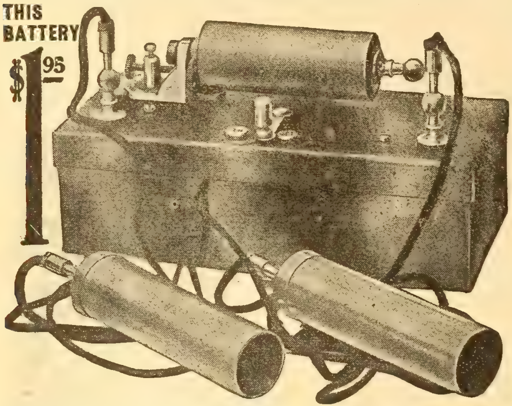

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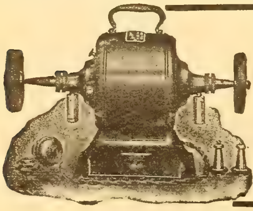

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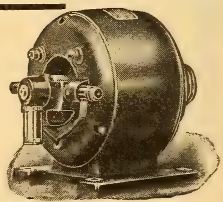

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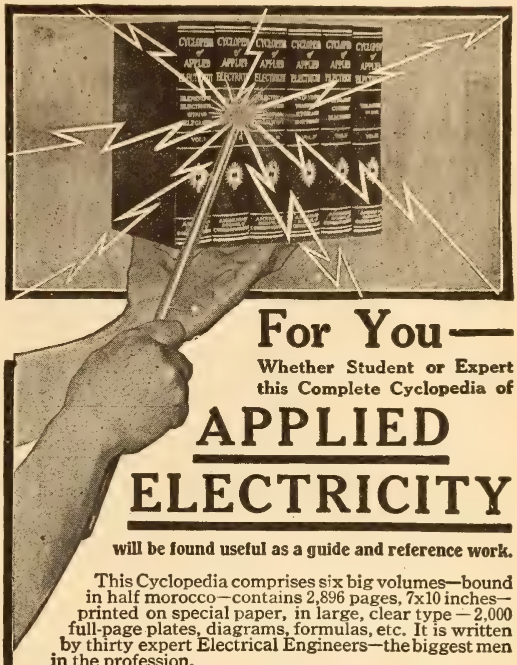

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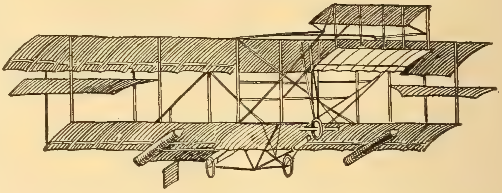

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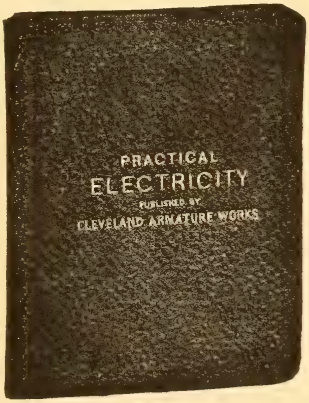

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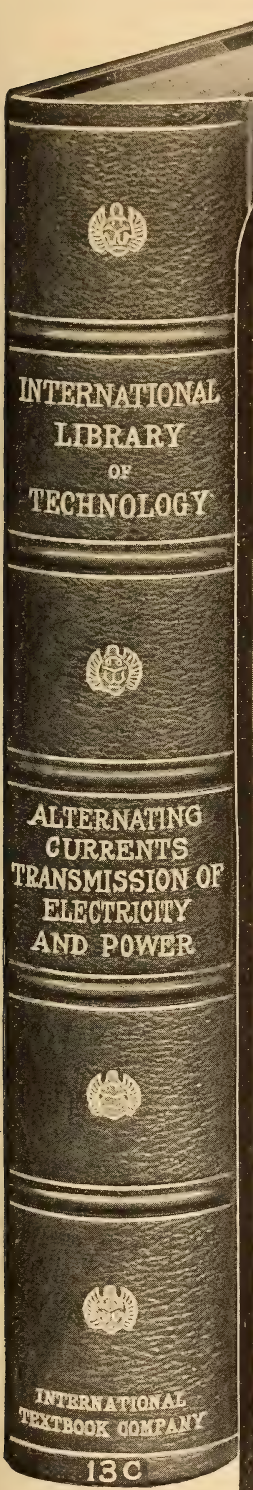
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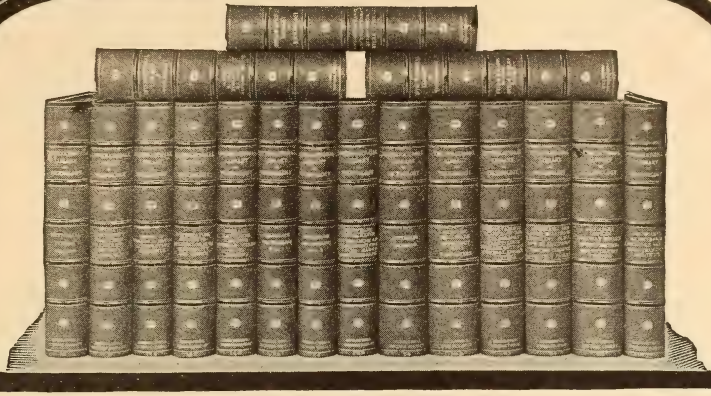

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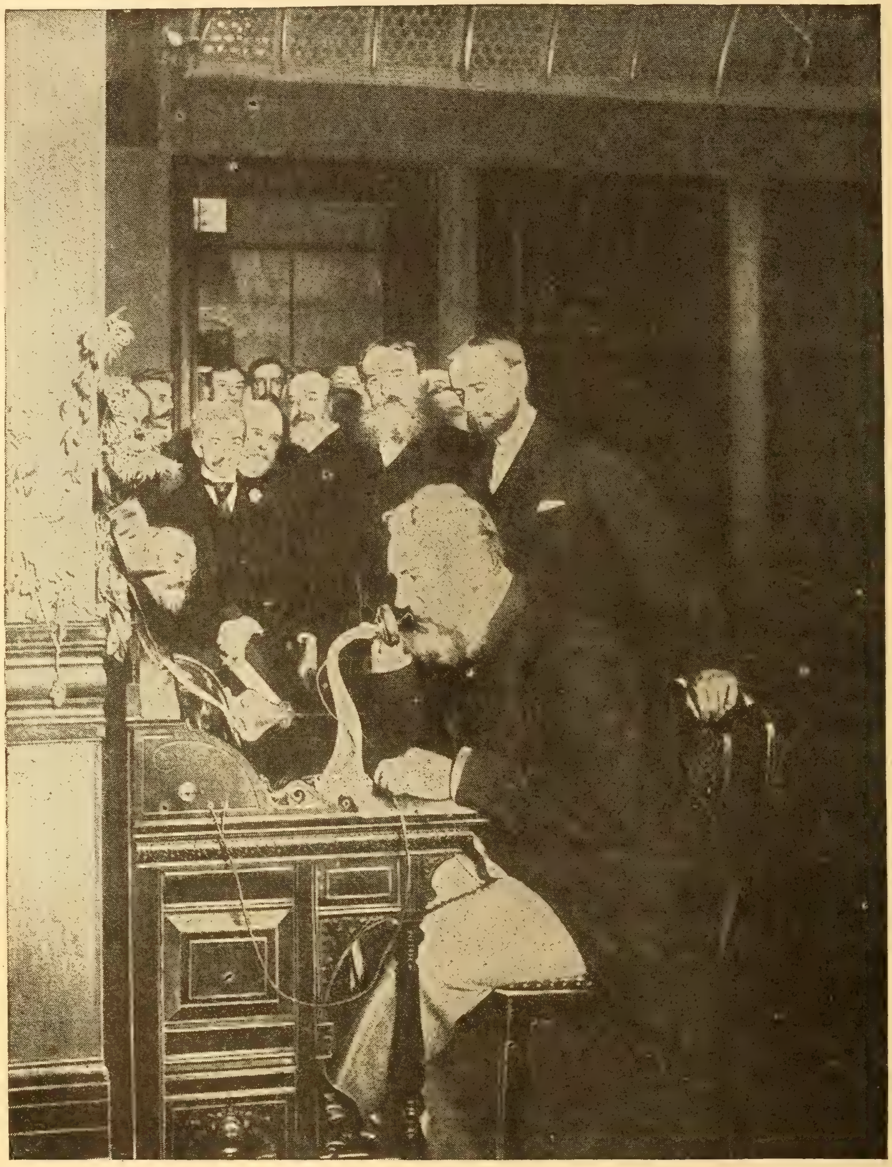

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By W. S. ANDREWS

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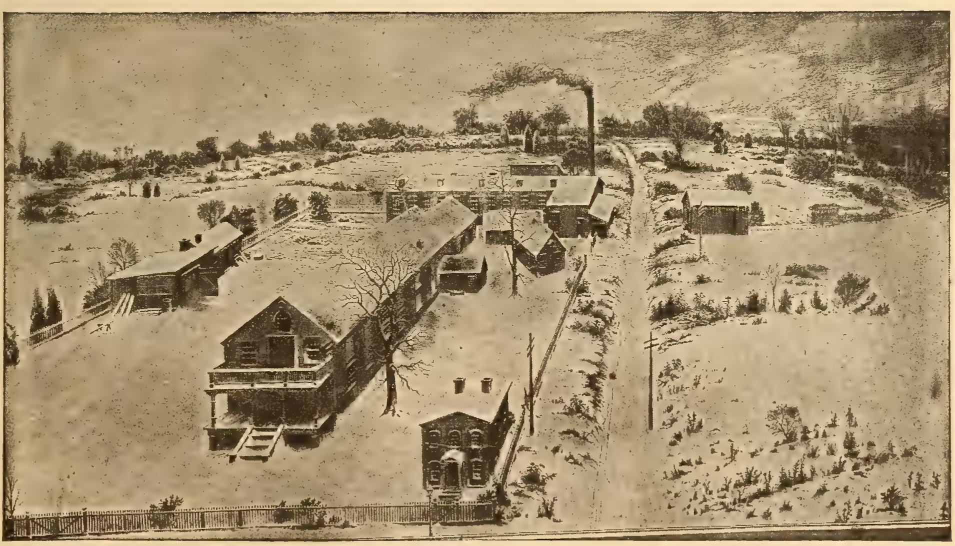
Thomas A Edison

FOREWORD

Thirty-one years ago, in the fall of 1879, the writer was living in the city of Newark, N. J., and he read in a local paper one morning that Mr. Thomas A. Edison had sent a messenger from his Laboratory in Menlo Park, N. J., to Clark's Thread Works (Newark) for a pound of their best white cotton, from some of which he had made a *wonderful electric lamp*. This statement impressed the writer so strongly that he determined to seek employment at the Edi-



MENLO PARK IN WINTER, SHOWING THE EDISON FACTORY IN 1880-81, THE BIRTHPLACE OF THE ELECTRIC INCANDESCENT LAMP

MENLO PARK IN SUMMER

son Works forthwith and learn something about this extraordinary invention. Fortune was favorable to his wishes and he is thus enabled to write the following account from his own personal notes and recollections, supplemented by much interesting information contributed by Mr. Chas. L. Clarke, Mr. Wilson S. Howell and others who were privileged to assist Mr. Edison in his wonderful electrical work at that time, to all of whom the writer extends his cordial thanks for their kind assistance.

In the year 1879 the Edison Works at Menlo Park, N. J., consisted of an office building, a well equipped two-story laboratory, power house, machine shop and numerous small buildings devoted to various branches of specialized work.

Mr. Edison with his assistants and employees were working literally day and night on the development of a system of electric lighting by incandescent lamps, including dynamos, with their accessories, all kinds of fittings and safety devices to be used in the distribution of current, meters for measuring it, and finally the lamps that were to prove the culminating triumph of his persistent endeavor and brilliant electrical genius.

The field ahead was virgin soil, in which little or no pioneer work had been done. Having no authorities to consult and no precedents to guide, many mistakes were naturally made, and all had to learn by experience which was sometimes expensive.

The first job given to the writer, was to assist in building a bipolar, direct current, shunt wound dynamo, which had been designed to run 60 sixteen candle-power lamps at about 100 volts. The field magnet of this dynamo was first wound with No. 10 cotton-covered copper wire. It naturally followed that the magnet coils absorbed all the current that the armature could produce. Then external resistance was connected in series with the field winding, but this scheme of course cut down the magnetism too much. The fact then became apparent that smaller wire should have been used in the first place, so the field was stripped and rewound. Better results pointed to the use of finer wire yet, so at last after several trials the best size of wire was determined by a purely "cut-and-try" process.

Various kinds of incandescent lamps were made with filaments of carbonized cardboard, wood and all sorts of vegetable fibres, etc. Mr. Edison aimed to make these lamps of about the same illuminating value as a gas burner that consumed five cubic feet of good illuminating gas per hour, the light being estimated at sixteen candle-power. It was soon observed that when the lamps burned with too brilliant and white a light, their life was short, and when their incandescence was weak and yellow it was of course unsatisfactory. Finally the experts began to make lamps so that they lasted pretty well and still gave light of fairly good quality and requisite intensity, and 110 volts was decided upon as a standard, for the reason that it was difficult to make any finer filaments that would be stable. One hundred and ten volts thus began to be recognized as the nominal standard for incandescent lamps, and after a time this standard became fixed and universal.

Notwithstanding many discouraging failures and mishaps, Mr. Edison felt from the very start so firmly assured of final success, that early in the year 1880 he began to make preparations for an elaborate public exhibition of his system, so that it became an actual necessity to carry on work simultaneously on all the different branches as before stated, including dynamo construction, lamps and fittings, underground conductors and fittings for same, and all the host of small paraphernalia that go to make up a complete system of electric lighting with incandescent lamps.

A system of underground conductors was laid out covering quite a large area of ground and extending in some directions more than half a mile from the power house Mr. Edison had not then considered the use of "feeders," "mains," and "services," which came into use later on, so these conductors were arranged on a plain two-wire "tree system," that is, they were started from the power house in the form of two big cables, each cable containing 25 No. 10 copper wires. Then where branches were required, the two cables were divided and subdivided until the end of the smallest branches consisted only of two No. 10 wires.

There was absolutely no previous experience to guide in the proper laying of these conductors, as this was the first installation of its kind. It was imagined, however, that the low pressure of 110 volts did not call for any expensive insulation against leakage, so ordinary cotton-covered copper wires painted with some compound of pitch were laid in shallow trenches in the earth protected only by *wooden moulding* and the usual covering board, similar to that now used for cheap interior wiring. The wires being laid

INTERIOR OF EDISON'S LABORATORY WHERE THE INCANDESCENT LAMP WAS DEVELOPED. FROM A PHOTOGRAPH TAKEN FEBRUARY 22, 1880

EDISON'S EARLY LAMPS WITH CARBONIZED PAPER FILAMENTS

in this moulding, were then covered with about six inches of earth, and the current was turned on. It was naturally discovered at once that the line was short circuited by excessive leakage between the conductors throughout their entire length.

An attempt was then made to insulate the line by opening the trenches, uncovering the wooden moulding and drenching the wires with boiling hot coal tar, but even after this treatment the insulation resistance was still found too low for practical service, and Mr. Edison's chemist discovered that the coal tar contained acid in sufficient quantity to destroy its insulating properties. Other experiments were then tried on short lengths of conductors but as they failed to show satisfactory results Mr. Edison confessed himself to be tired of haphazard trials, and he requested Mr. Wilson S. Howell to go into his library, read up the subject of insulation and insulation material, and make a report thereon with recommendations. When this report was finished Mr. Edison approved it and the various materials suggested for trial were purchased, together with a supply of pots and kettles, and Mr. Howell was installed in the chemical laboratory with instructions to produce a cheap and effective insulating material.

For some time thereafter Mr. Edison's chemist and his assistants were choked and distracted by the stenches and smoke of the various "cooking operations." The experiments were made on 100-foot lengths of No. 10 copper wire and when a promising mixture was produced, the wire was served with the compound held in place by muslin tape, and after being coiled up in a tank of water it was tested for insulation. The best of these insulating compounds was finally selected for use. It was composed of refined Trinidad asphaltum, mixed with oxidized linseed oil to give it the right consistency, and a little paraffin and beeswax were added to make the material smoother. Two or three tons of Trinidad asphaltum were bought, with a few barrels of linseed oil and litharge with which to oxidize the oil, several bales of cheap muslin, and some paraffin and beeswax.

Two 50-gallon iron kettles were mounted on brick work, and the compound mixed in these kettles. The muslin was torn in strips about two and one-half inches wide for the largest conductors, and passed through the compound while hot, and made into rolls to facilitate the winding of the conductors, this being always performed by hand.

The wires were then taken up from the trenches and supported above the earth on short saw-horses. The method of winding was necessarily crude. A small boy straddled each cable, walking out towards the end of the conductor as he served the insulating tape carefully thereon. After he had proceeded ten feet or so from the home end of the conductor, a second boy was started out with a second roll of tape, and this one was again followed by a third boy; so that three servings of tape were put on each conductor, which was then laid back into the trenches, the wooden molding having been removed. Each line was then tested, and the insulation was found to be remarkably good.

The first line laid with this improved insulation ran from the dynamo room past Mr. Edison's house and along the tracks of the Pennsylvania Railroad Co., and it was finished just previous to election day in November, 1880. A row of incandescent lamps on wooden posts had been set up along the tracks, connections made and everything put in order for a trial run.

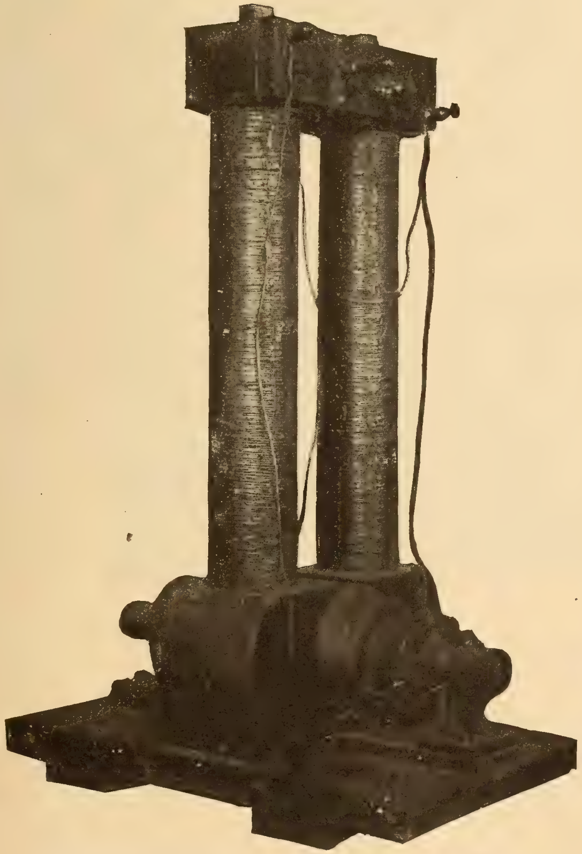
When informed that the line was ready for turning on the current, Mr. Edison's reply was characteristic:

"If Garfield is elected we will light up that circuit. Otherwise we will not light it."

Several of Mr. Edison's assistants gathered that evening with him in his laboratory to receive the returns. Mr. Edward H. Johnson was at the telegraph key which was in a loop run from the lines along the railroad tracks. Careful tally was kept of the returns, and when the result seemed certain, Mr. Edison gave orders to light up the circuit. Steam had been kept up and the dynamos were running, so the switch was closed and forthwith the long row of incandescent lamps by the railway tracks beamed forth brightly through the darkness of that night in November, 1880, when Garfield was declared elected—the first use of incandescent lamps to celebrate the election of a President of the United States!

The problem of temporary insulation being thus solved, the system was rapidly pushed to completion, and rows of wooden lamp posts, topped with waterproof globes of clear glass containing the incandescent lamps, appeared along the streets and roads of the village. The illumination was also extended along the adjacent country roads and even into the neighboring woods, some of the lines running more than half a mile from the power station. The Edison Laboratory, machine shop and adjoining buildings were completely wired and fitted out with lamps, and also many of the surrounding dwellings.

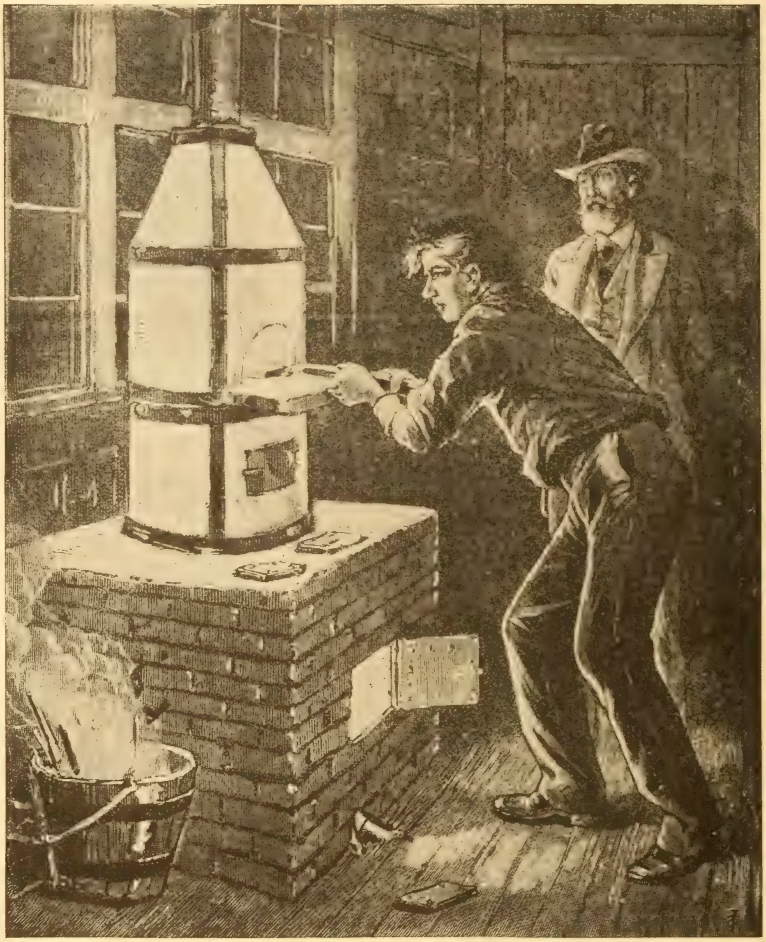
In the meantime the number of dynamos was increased until the installation included ten of the before mentioned 60-light machines which were all belted to counter shafting driven by



THE OLD TYPE "Z" DYNAMO—SEVERELY SIMPLE, BUILT FOR GOOD SERVICE an 80-horsepower Brown engine. The field magnets of these machines were separately excited by an independent dynamo.

The lamps used were of two sizes, classified as A and B. The A size was calculated to give sixteen candlepower, and the B size eight candlepower. The A lamps were made as nearly as possible for 110 volts, and the B lamps for 55 volts, so that the latter could be connected two in series across the line.

It was naturally impossible to construct all the lamps of exactly the same voltage, so they were sorted out, and those of the highest voltage were used in the vicinity of the power station where the loss on the lines was the least, while the lamps of the lowest voltage were connected at the ends of the longest branch lines where the drop was greatest. In this way it became possible to operate all lamps at approximately normal voltage and thus obtain the best results. When about 500 lamps had been connected to the system, Mr. Chas. L. Clarke made his famous test to determine the efficiency of the Edison lamp, and prove the commercial possibilities of the new system as a competitor with gas lighting. Considering the novelty



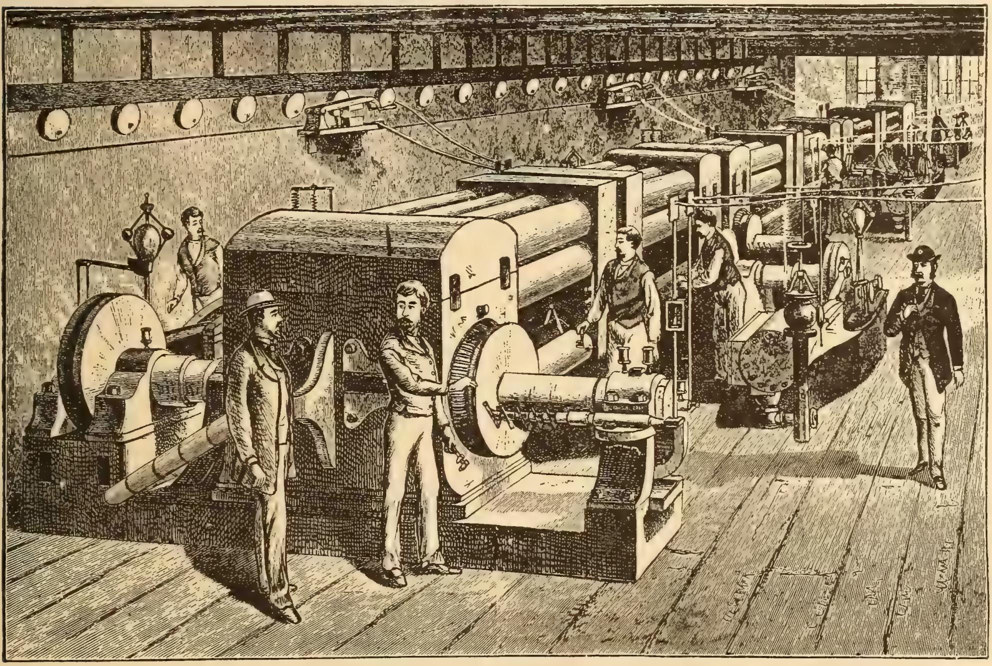
EDISON FIRING PAPER FILAMENTS. FROM AN OLD DRAWING SHOWING THE ARTIST'S CONCEPTION OF HOW THIS INTERESTING OPERATION WAS PERFORMED of the art it is not surprising that the efficiency of the lamps proved to be rather low (between seven and eight sixteen-candle-power lamps to the horsepower) but their durability was very remarkable as only three of the A lamps burnt out during this twelve-hour test, and none of the B lamps failed.

In the spring of 1881, when the installation was practically complete, Mr. Edison extended an open invitation to the public to visit Menlo Park and see his new system of lighting in actual operation. Many thousands of people responded and came from far and near to gaze at the glowing lamps, and many amusing stories could be told of questioners who wondered how these lamps could be lighted and extinguished, what kept them burning, and what sort of stuff they consumed, etc.

The following quotation from the *Scientific American* of June 18, 1881, indicates to some extent the appreciation with which this grand achievement was publicly received.

"Simply as an exhibition of perfect illumination under perfect control, covering a vast area, this array of lamps presents a most remarkable and delightful sight, and is alone worthy of a trip to Menlo Park. As a demonstration of the perfected working of a great and novel system of illumination, sure to become in a little while a potent contributor to the comfort and economy of city life, it is a spectacle which cannot fail to impress powerfully the mind of any observer."

The underground conductors still maintained their insulation and the dynamos and lamps continued to work well, but as Mr. Edison found it desirable to move his works to New York City, this first Central Station outfit was abandoned in the summer of 1881, the purpose of its installation having then been fully accomplished.



INTERIOR OF THE PEARL STREET STATION, NEW YORK CITY—ONE OF THE FIRST CENTRAL STATION LIGHTING PLANTS TO BE ESTABLISHED AFTER EDISON'S EXPERIMENTAL STATION AT MENLO PARK

Thirty years may seem to be rather a long retrospection, and yet how short a period it really is when we consider the magnificent and wide spread results that have developed in electric lighting during its flight.

The *first experimental* central station plant for lighting with incandescent lamps with a two-wire underground system of distribution was installed by Mr. Edison at Menlo Park, N. J., and was started in November, 1880.

The *first commercial* central station was started to generate current for public service on the two-wire system on Holborn Viaduct, London, England, in January, 1882, and was closely followed in this country, first by a small plant in Appleton, Wis., and soon after by the famous Pearl Street Station of the Edison Electric Illuminating Co., of New York, which distributed current over a territory about one mile square.

The *first three-wire* Edison central station plant was started in Sunbury, Pa., on July 4, 1883. What do we now witness in 1910, only thirty years after the first practical incandescent lamp was made?

In every large city we find immense generating stations supplying current directly or through sub-stations to millions of incandescent lamps and other transformers of electrical energy and indeed there is hardly a village of any importance that is not blessed with electric light!

As to the amount of profitable financial investment and the countless thousands of individuals who are thereby privileged to earn comfortable livings in electrical pursuits the writer is unable to give any close statistics, rapid growth outstripping records. An authoritative statement has, however, been made that more than one billion dollars is now invested in this country in electric lighting plants whose pedigrees may be traced back to that first experimental central station that was started by Mr. Edison in Menlo Park, N. J., in 1880, and which marked in the history of the world the commencement of the Age of Dynamic Electricity.

FROM OUT THE LEYDEN JAR

All the telephone subscribers of the state of Texas can receive the weather reports free of charge by asking central.

* * *

In the canal zone it is the custom to keep electric lights burning inside pianos to prevent the wires rusting.

* * *

The city of Bangkok is the only place in Siam lighted by electricity.

* * *

Sixty per cent of the patents granted yearly in this country are worthless. Nearly ninety per cent of the electrical patents are practical.

* * *

After elaborate tests the Navy Department has installed electric ranges and electric bakers on the *Dixie*, and is considering electric cooking upon practically all the battleships and cruisers. The tests of these cooking devices were made at the Navy bakery school near Newport, R. I.

* * *

The Singer Building, New York, contains 3,425 miles of electric wire says a technical writer.

* * *

It is well to remember that many of the soldering fluids in common use are injurious to tools as well as to parts that may be laid on the bench where such fluids have been used.

* * *

Metallic radium has been isolated by Madame Curie in collaboration with Monsieur de Bierne. The metal is highly oxidizable, and from a clear white soon becomes black. It adheres firmly to iron, decomposes water, burns cellulose, and is rapidly dissipated. This pure element was obtained by electrolysis of the salt, by which means a miligramme of radium amalgam was secured, and on distilling off the mercury at a temperature of about 700° C., the pure metal was left behind.

* * *

The Marconi company has installed wireless telegraph outfits on eleven warships of the Turkish fleet, and in a land station at San Stefano.

* * *

Barges filled with stone and sand are now unloaded at the Gatun docks on the Panama Canal by the aid of search lights which cast light on the barges at the dock and over the storage piles. The searchlights are 18-inch standard Navy projectors, and are operated by a motor generator which converts current supplied at 600 volts from the power plant to current at 125 volts for the lamps.

The Telephone Operator as I Know Her

By H. N. FOSTER

The telephone operator has been inspected by the government and the report is filed. This report gives the height, the health, the age, the hours, conditions and wages, everything that expert sociological investigation can give.

But there are some things which must elude the inspector's eyes, however thorough he may be. The telephone operator is to him a well trained young woman, one of the many business girls of America, and she will take her place with the thousands of others in other lines of work when the report is published.

But there is a different picture in my mind. When I see the words "telephone operator," I do not see the sum total of the requisites of height and age, eyes and ears and education. These are but the skeleton of the person I know. She is all this, but she is so much more. She is not a business machine—merely an automatic servant of the public. To be sure, she has the poise which has come from discipline, she knows how to co-operate with others, she repeats her phrases correctly and conforms to rules, but she is far from being a machine. The summing up of these things does not make the picture of the telephone operator as I know her.

The telephone operator's work requires her undivided care and attention. She is one on whom rests the responsibility each day of assisting in handling a vital portion of the city's business. She is closely in touch with the pulse of the business world and the rise and fall of the traffic indicates to her the degree of its activity. Whether the traffic is high or low, the calls numerous or light in number, she realizes it is her part to meet the situation and continue to render service in an efficient and satisfactory manner. She cannot begin to estimate the importance of the individual calls which she continually handles, but must see that each is connected quickly and accurately; but when emergency calls are received such as fire and police alarms, and calls for ambulances, it is then she must think and act most quickly, often assisting the one who is calling, but who is too alarmed or frightened to do his part in summoning assistance.

Let me give a few sketches which help to make the composite picture which comes to me when I think of the telephone operator.

It is nearly five o'clock. The day force is beginning to realize that their day's work is nearly done, and the evening force is assembling in the operators' quarters preparatory to coming on duty. The busy hours of the day are about over and the heavier hours of evening work have not begun. The normal traffic is being handled easily and only a faint murmur of the operators' voices is heard in the operating room. As the force is getting ready to change, suddenly the boards are seen to be ablaze with signals. The operators, though surprised and wondering, immediately undertake to meet the unexpected rush in traffic, and make the connections as fast as called. The evening force comes into the room, but there is no thought, on the part of the day operators, of leaving their positions. There is no suggestion that they are tired from their day's work, or anxious to get home. They all realize the emergency which is back of the frantic calling, and day and evening forces together, often two to a position, one sitting, the other standing, turn to meet it without a murmur. It is no patient public, which they encounter. Wildly excited, begging imploring, crying, they are calling for numbers that are always busy. The morgues, the hospitals, the newspapers, any one whom they hope can give them information—for it is the terrible theatre fire, and the telephone girls, many with tears streaming down their faces, are working hand in hand, with the desperate subscribers. They are no automatic machines mechanically serving the public. Every nerve is alive to the situation, and they are putting forth every effort to serve the people whom they cannot see, but with whom they sympathize and suffer. The overtime work goes unnoticed, and they work, relieving each other, until late in the evening, at times pulled away from the board almost fainting to be revived with nourishment, only to go back again to help with the connections.

I see an office, orderly and quiet. It is eleven in the evening and work is light. Suddenly there is a terrific noise, more sudden than thunder, shaking the very foundations of the boards where the girls are sitting. With it is heard the crash of falling glass and snapping timbers. A word of direction from the manager, and every girl's face is toward the board, and with fingers that tremble and voices that quaver, the brave telephone girls meet the sudden increase of calls. And day girls sleeping in their homes respond to the call to come again to the office. Not a complaint; for it is not a machine that responds because it has to; it is a thinking, responsive personality, meeting the emergency calmly and bravely, each girl giving herself to the work she has chosen.

STILL UNAFRAID THEY LEAVE WITH REGRET, WAITING TO PUT UP A LAST CONNECTION

Take another view that helps to make up the composite picture:

A generator is gone. It will be ready again at any moment. There at the boards sit the girls waiting, watching, alert. It is the busy time, but they are helpless. Thirty-five minutes they sit there, and it seems hours. The strain is more intense than when a full board calls for most active service. These are the ones who serve when kept from service, the hardest task sometimes.

Again, a gas main has broken. The insidious poison is penetrating an operating room. The girls are wondering why it is so hard to work; why the numbers are so blurred; wonder why they seem to rock in their chairs, and then why they are opening their eyes in the rest room. They worked till the mind could act no longer; they fainted at the board.

In the dense smoke and under dripping ceilings I see girls who calmly serve their subscribers, who little dream that "Number, please?" comes from an operating room threatened with fire and filled with smoke from the blazing building next door. They may be in no danger from fire, but the smoke becomes so dense that they can hardly see the numbers. It is only when blinded eyes and choking throats refuse to serve longer that they move away from their places which others stand ready to fill. The service must never stop. That is the determination of the telephone Company and likewise of the devoted operator, and she does not hesitate at suffering to accomplish that purpose.

And I see them when fire is blazing in the very room where they work. With fine self-control they sit at their posts, trusting to the manager and the firemen; their faces to the board, illuminated now by the blaze, they calmly make connections while the crackle of the fire and the confusion of putting out the blaze added to the stifling smoke, makes such service the proof of character strong and faithful.

Finally, when the word is given that the room must be abandoned, still unafraid they leave with regret, stopping to put up a last connection; then forming in line, and carefully selecting their way through the confusion of water and wreckage, and through the crowds that have assembled, they gather to await the earliest summons to return to their posts of duty.

And here and there, everywhere, are girls who come to their work from homes where they would often prefer to stay. Here is a girl whose father is ill; he does not lack for care, but it would be pleasant to stay at home. But the force would be short; she is needed; she sets her mind to her work and all day faithfully puts her own private care aside to serve where she is needed.

The street cars are not giving service. For weeks the cars are held up. The more extended the lack of city service, the more essential is the service of the telephone. She is needed more than ever at her exchange. She walks miles to get there; she begs rides on milk wagons; she climbs up into express wagons; even rides in the police patrol. Get there she will.

Through blizzards and blinding storms of wind and rain, she goes, defying nature itself to keep her away from her place of duty.

Always willing to meet the demands of unusual traffic caused by special events, to work the unusual hours, such as evenings, Sundays and holidays in order that the public may have continuous service, could we expect a catalogued report to describe even in a general way the qualifications which go toward making up the telephone operator as she is today?

This composite picture is a "Telephone Girl" of character; unselfish, devoted, brave, resourceful, loyal, ready for emergencies; trained to be like all other telephone girls, to be sure, but trained only to bring out the qualities which prove her to be a noble woman—the telephone operator as I know her.

In Quest of a Voice

By FLOYD HAMILTON HAZARD

The faint, sweet tones of the voice, which seemed to reach out to him through the vastness of space—persuasive, yet distant; clearly distinct, but without volume—had awakened within him a sense of half-forgotten kinship. He was, however, completely at a loss to account for the insistence with which his mind dwelt upon them.

Their vague, but compellingly attractive quality had haunted him for days, continually suggesting retrospection; pleasant, though indistinct memories, tinged with the sadness of irredeemable loss; the joy of newly aroused hope, and the sorrow of baffled realization.

Try as he would, there was nothing upon which to base, definitely, a rational solution of their power over him, nor was he able to dismiss a matter which had almost become an obsession.

It worried him.

The voice was that of a woman—of that much he was certain—but it was not the voice of any woman he knew. He had formed the habit of listening for it daily, in the hope that some suggestion might be made which would enable him to discover the owner, but he had had no success.

Sometimes he failed to hear the voice, and was annoyed thereat.

He was also greatly annoyed at being annoyed thereat.

Van Doren was not given to morbidness. In fact, he was an extremely optimistic and wide-awake young contractor. But when the laughing notes of that same voice came joyfully up the elevator shaft from the car that had just shot downward past the twenty-third floor, he had felt a momentary quake of fear that all was not right with him. Instantly he had recognized them, but it was startling, indeed, to hear them this time full, rich, and distinct.

His expression of surprise, which had almost amounted to consternation, changed to one of alert eagerness, and he sprang to the grating, to peer down the shaft. The car was far below, and none of its occupants was visible. But, though he was disappointed over his failure to see them, there was much relief expressed in the tone with which he addressed his friend, Fred Osgood.

"Well! Thank goodness it's a real voice and belongs to a real person! It isn't the ice of some spiritual affinity of mine."

It was considerably past the noon hour and the two were waiting for the elevator, on their way to lunch, in the rathskeller of the building.

"What's the matter with you, Ted? Aren't you well?" exclaimed Osgood, in utter astonishment at such an outburst from his friend, in the midst of what had been a purely technical conversation. "Of all the dippy things I ever heard you say, that's certainly a winning sample."

"Do you mean to say, Fred, that you didn't hear that girl's laugh?" asked Van Doren, beseechingly.

"Why, of course I heard it. But what of it? Heavens and earth, Ted! What's got into you?"

"I don't quite know. At any rate, I'm mighty glad to be able to state that *I* heard that girl laugh; that it is the same voice I have heard many times before—under unusual conditions—and that, since you have also heard it, I am now *sure* my wheels haven't been turning around too fast. I was extremely doubtful about that latter question, a few moments ago."

"How long have you been interested in girls' voices, Ted?" asked Osgood, as they stepped toward the door of a car. "I thought they had no attraction for you."

"This is the tenth day."

"How very exact you are," said Osgood, mildly amused. "Why are you so interested?"

"Don't know much about that part of it myself," rejoined Van Doren. "However, I'll tell you what little I do know about it while we are at lunch."

They found a table for two, in a quiet corner of the rathskeller, and after their order had been taken, Osgood leaned eagerly forward.

"Now, Ted, tell me what this is all about," he said. "I'm quite excited about it."

"Well, in the first place, there's nothing the matter with me, except that, as nearly as I can judge, I'm in love with a voice—for keeps—and I can't find the girl who belongs to it," announced Van Doren, despairingly.

His friend stared at him, gravely speculative.

"Then I was right, after all," he said. "You *are* crazy."

"Not a bit of it," objected Van Doren. "There is, however, such a possibility in the future, unless I succeed in solving the problem."

"It is a problem, that I'll admit," said his friend, soberly. "When did you begin to notice the first symptoms of this, er—a—this trouble?"

"Hold hard, old man. I'm coming to that part of it," continued Van Doren. "You know it is our custom to call each other on the wire about four o'clock every afternoon, just so as to keep track of ourselves."

"Yes, and we both need it," replied Osgood, smiling.

"Some time ago, I noticed that whenever I called your number, I could faintly hear other voices in conversation. Sometimes they were almost entirely inaudible and at other times I could hear whole conversations distinctly, although, even then, they were fainter than the faintest whisper.

"In particular, there was several times a conversation—which I could only hear with difficulty—between some girl and a man who was evidently either her husband, or an old and trusted friend."

"Don't say 'old and trusted friend,'" interrupted Osgood. "Say 'trusted friend.' We don't want to spoil a possible romance."

"This is no joke, I tell you, Fred. You keep quiet and listen. Day before yesterday, not knowing that you were out of town, I called your office at the usual time. I was wondering why you did not answer your telephone, when I heard these two in conversation again.

"If you remember, it had rained all the preceding night; and, either for that reason or for some other which I do not understand, the voices—though still very faint—were very distinct indeed."

"Didn't you try to make them hear you?" asked Osgood.

"Yes. I butted right in and attempted to get their telephone numbers, but it was of no use. They went on to talk about other things and evidently couldn't hear a word I said.

"Since then, I've done everything I can think of to get some clue as to who they are—because the girl's voice seemed familiar—but so far I've been unsuccessful. I'd even begun to think it was all my imagination until today, when I heard her voice in the elevator that passed us. Never had such a swift jolt as that in all my shocking life."

"Should think it might have been a bit surprising," Osgood remarked. "Had you thought of trying to find her through the telephone office?"

"No, I hadn't."

"Say, Ted!" exclaimed his friend. "I have an idea. You say that it is only when connected with my line that you hear these voices?"

"Yes. There's not the slightest hint of anything of the kind, except under the conditions I have mentioned."

"Then there must be something wrong with my line," said Osgood triumphantly. "By finding out what that something is, we may possibly be able to locate the source of the voice. It's the most romantic situation I've ever heard of, since I stopped having them myself, and I'm going to help you to solve the puzzle."

"How are you going to do it?" asked Van Doren, skeptically.

"We'll go and see my friend Treadworth. He's in the telephone business. Has charge of one of the downtown exchanges, I believe. Now that I come to think of it, my own line connects to the exchange he is in. At any rate, he'll help us out if he can."

"Fine!" exclaimed Van Doren. "Anything is better than suspense and this feeling of utter helplessness. When can you go?"

"Just as soon as we are through with our luncheon. I've an hour or two to spare if necessary."

Van Doren and Osgood had been close friends ever since their first year at college. Circumstances had permitted the continuance of this friendship—with brief intermissions—after their graduation; and, although Ted was an engineering contractor, and his chum a lawyer, they had many interests in common and sought each other's society whenever possible.

Leaving the restaurant, which was near the post office, they walked briskly along Broadway, discussing the possibilities and probabilities of the case all the way to their destination.

They were about to enter one of the elevators in the telephone exchange building, when Osgood laid a restraining hand on

Ted's arm, and turned toward a man who had just come down the stairs.

"Hello there, Treadworth," he called, drawing Van Doren along with him and walking up to his friend. "I want you to meet my old chum Ted Van Doren. We've dropped in to see you on some very important private business," he added, as the two shook hands, "but we can just as well talk it over and be sociable at the same time. Let's step across to Black's. You're in no hurry, are you?"

"Never was in a hurry but once in my life," replied Treadworth, laughingly. "That was when I was a boy, and fell out of a cherry-tree."

After the three were comfortably seated in the cafe and had lighted their cigars, Osgood proceeded to tell Treadworth the salient points of the problem which he and Ted were trying to solve.

"You see, Joe," he said, "it's not so much that there is evidently something wrong with my line—because it doesn't seem to interfere in the least with my service—but it's quite important that we locate the two people of whom I speak. Do you think we can do this by locating the telephonic trouble?"

"It's your only hope, as far as I can see," answered Treadworth.

"It's rather difficult, because it is evidently not a direct crossing of the wires. If that had been the case, these people could probably have heard you, Mr. Van Doren, and you could have possibly persuaded them to give you the numbers of their telephones. That's all we need for your purposes. If I can find out what their numbers are, I can easily give you the names and addresses of the people who have the telephones; and, after that, the rest ought to be a perfectly easy matter."

"But I could hear them so distinctly that last time," said Van Doren. "It seems strange that neither of them could hear me."

"Can't help that," replied Treadworth. "There's no limit to the impossible things that can happen in this business—and which do happen, every day. It's positively weird."

"What do you think is the cause in this case?" asked Osgood.

"Well, I think that probably it is a case of cross-talk, caused either by induction or by some slight grounding of your wire and one of their's. It might be a direct cross of very high resistance, but I am inclined to doubt it."

"Whew!" exclaimed Van Doren. "Is it as bad as all that?"

Treadworth laughed.

"Can you do anything for us in regard to locating the difficulty and by so doing get the addresses, do you think?" questioned Ted, with evident anxiety.

"Yes, I think I can," answered Treadworth, pulling on his gloves. "I'll drop into the office after five o'clock and make some tests. Just now I've got to go up town. I can get a better line on the electrical conditions after business hours, when the lines are pretty quiet. I'll also do some testing through the day, tomorrow. If you will come to my office about fifteen minutes before the time you have usually heard these people talking, we may be able to get some results."

"I'm sure I don't know how to thank you for your interest," said Van Doren, sincerely, as he and Osgood parted from Treadworth.

"Oh, that's all right," he rejoined, as he bid them goodbye. "I have a personal interest in the matter myself. The technical side appeals to me."

As Osgood had a dinner engagement, Ted announced that he was going up to the club.

"Guess I'll eat there and then get one of the fellows to go to the theatre with me," he explained, as their ways divided. "Got to do something to occupy my mind, until I get this matter settled—one way or the other."

"Best thing you could do, by all odds," said Osgood as he prepared to swing aboard a surface car. "Now, don't fail to let me know tomorrow in case you discover anything. So long."

Van Doren spent a feverish evening, and his dreams that night were a tangled maze of twisted wires, telephones, and imaginary young ladies with real voices.

When it came time for him to go and see Treadworth, the next day, he was forced to acknowledge to himself that he had practically accomplished no work at all; and he was glad indeed to get away from business until he could better control himself.

Entering Treadworth's office, he found that individual seated at the left end of a long, bureau-like desk, and entirely too busy to do more than to nod to him and to motion him to a seat.

It was the first time that Ted had ever been in the testing room of a big telephone exchange and he noted at once, with interested surprise, its tense atmosphere. Treadworth, and the assistant at his right, wore receivers which were clasped to their heads, so that their hands were free.

The portion of the big desk which corresponded to the upright, mirror part of a bureau, was filled with a multitude of small electrical signals and with a number of electrical testing instruments.

Each man had a separate set of apparatus and was busily engaged in manipulating small switches, reading the indicators on the various instruments, noting the results on the records, and talking, talking, talking incessantly—apparently each to himself.

He felt awed by their complete concentration of effort and their nonchalant handling of unseen forces.

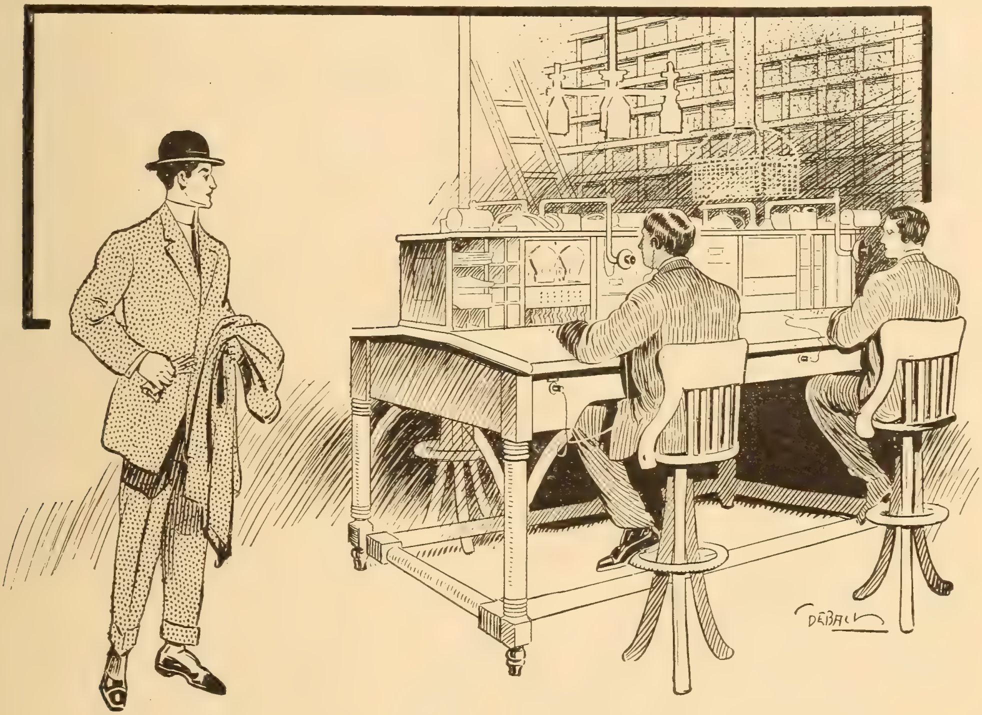
His eyes wandered to the racks, with their maze of wires. He noted the humming of the dynamo, the shouting of the orders across the room, and the quick response of the men who executed them.

All this found him at a loss for a basis of comparison.

About the only thing he could recall having seen that was in any way similar, was the controlled excitement prevailing in the editorial rooms of some great newspaper, during the period immediately preceding the time for going to press.

"Good heavens, Mr. Treadworth," he exclaimed, as Treadworth arose from his chair and came over to greet him, "You don't have to drive like this all the time, do you?"

"Yes, pretty nearly. There's seldom any let up. When there is a lull, something is sure to happen to make up for it. It's these emergency conditions and the consequent irregular hours due to extra work and to night work that's killing, however. We soon get used to the ordinary work, such as you see, and live on the excitement of it, to a large extent."



EACH WAS BUSILY ENGAGED IN MANIPULATING SMALL SWITCHES

"I'd lose my wits inside of a week," asserted Van Doren, with firm conviction. "But—any results in the detective line?"

"Reporting progress, I'm glad to say," rejoined Treadworth, as he began picking out some cards from the record case. "There's a slight leak to ground on Osgood's wire, and I've located it in the big switchboard."

He handed over to Ted the cards he had been sorting out.

"Those represent the eight lines which are adjacent to Fred's line in the multiple of the switchboard," he said. "Look them over and see if you recognize any of the names or addresses."

Van Doren shook his head sadly as he rapidly glanced them over.

"No clue here," he said with regret. "None of these names are familiar to me."

"Hold on a minute," he added. " 'The Southern Construction Company, Earl Court Building.' Why, that's the building Osgood and I were in yesterday. I heard the voice of one of the people I am trying to find, in a passing elevator, but could not see who it was."

"It wasn't a woman's voice, was it?" inquired Treadworth, mischievously.

"Well, yes. It was," Van Doren replied, reddening.

"Oh," said Treadworth, but his tone gave evidence of considerable comprehension.

"Do your tests show that this line is the one which is interfering with Osgood's," asked Ted, ignoring the impeachment.

"Well, I'm in doubt about it. Several of the other adjacent lines show almost the same amount of leak. I'd like to have you listen for a while on Fred's line. It will help to make sure."

"Only provided that you'll guarantee not to make a telephone man of me," said Van Doren, with a shrug. "That sample of your duties which I have just witnessed rather frightened me."

"All right," laughed Treadworth. "I promise."

They entered the switch-room and stopped before a position of the switchboard that had just been vacated by the operator. Treadworth handed his visitor a telephone receiver attached to which was a flexible, green-braided cord, that terminated in a metal plug of peculiar design.

"What's it for?" asked Ted, accepting it doubtfully.

"Put it on your head and I'll show you."

Ted adjusted the receiver and looked at Treadworth expectantly.

"Now," explained his instructor. "All these holes in the upper portion of the switchboard, furnish points of connection to the various lines in this exchange. We call them 'jacks' and the whole collection of jacks we call the 'multiple' of the switchboard, because they furnish a multiple number of points of connection to each of all the lines we have. The plugs at the ends of the flexible cords you see the operators using, connect to other wires, and as each operator has in front of her at least one of the jacks on any given line, she can connect any line with any other line, by inserting the plugs of her cords in the proper jacks."

"Very interesting," said Ted, "but what am I to do with this thing?" indicating the plug which dangled from his head-receiver.

"I'll show you," replied Treadworth. "Here is the jack which connects with Osgood's line. Immediately below it is the jack which connects with the line of The Southern Construction Company. Put the plug which is attached to the cord of your head-receiver into the jack on Osgood's line. Now, if those people you are after talk to each other, you will be able to hear them just as if you were at your own telephone—except that you will probably hear them more distinctly. If you do hear them, remove the plug at once, and insert it in the jack below. In case we are right in our opinion that the two lines are crossed, you will then hear the same conversation between these people just as plainly as they themselves can hear it. You see, both lines are slightly grounded by some moisture and the current leaks from one to the other through the insulation."

"Proof positive, eh?" said Van Doren, admiringly. "They ought to be talking right now, unless this is one of their off days."

He listened intently for a moment or two, and then, with a sudden movement, changed the plug to the jack below.

"Right oh!" he exclaimed. "That's the line. Treadworth, you're a wonder! The conversation was too brief to get much real information, but I've the satisfaction of knowing that I'm on the right track, thanks to you. What she said was, 'Is that you, Will?' and then asked at what time they were to dine. He answered, 'At seven o'clock.' "

"Sure it was the same person?" asked Treadworth.

"I'm certain of it."

"What will you do now?" asked Treadworth, as they returned to his office.

"I'm going over to see Osgood and make up some excuse to call at the office of The

Southern Construction Company. As a lawyer, he'll be better able to invent one than I."

Treadworth laughed at the sally, as the two shook hands in parting, and made light of Van Doren's assurances of the deepness of his obligation to him for such quick and valuable assistance.

"I'm grateful to *you*," he said. "You've put me wise to a trouble which I can now clear before a formal complaint is made by the subscribers whose lines are affected. Goodbye. I wish you luck."

Van Doren found Osgood preparing to close his office for the day, and briefly stated his mission.

"I want you to come up with me to see those people," he said.

"But I don't know any firm by that name, Ted," replied his friend.

"No more do I. I'm just taking a blind chance that something will develop. We'll think up our excuse for calling, on the way. It's getting late and we'll have to hustle or they'll be closed up."

"We can drop in on them, I suppose, and go from there to the club for dinner," said Osgood, doubtfully. "I don't see what you'll gain by it, though," he added. "You, a stranger, can't cross-examine their entire force in order to find out who it is that has a seven o'clock dinner engagement."

"That's true enough," replied Ted, with some impatience. "But I can look around, can't I, and read the names of the firm's managers on the office doors, and all that sort of thing?"

"Well, there's one chance in a million that you may in that way get some definite information. However, we can at least find out who runs the concern. What'll you say? Ask about engineering supplies or contracts? Perhaps that would be as good an excuse as any."

"Of course it would, but somehow I hadn't thought of it," Ted agreed as they neared their destination.

It was a quarter past five o'clock when Van Doren and Osgood arrived at the entrance to the offices of The Southern Construction Company.

They feared they were too late, but as Van Doren reached to open the door, it swung inward and a stockily built young man stepped hurriedly out and almost into his arms.

(To be concluded.)

What Voltage Causes Death?

At a recent meeting of the British Medical Association Dr. S. Jellinek, of Vienna, read a paper on "Disorders and Death Following Electric Shock," He stated that, while in some cases fatal accidents had been brought about by shocks at 100 volts, in other cases, in which the voltage had been 1,000, and even 10,000, recovery had ensued. In order to understand a matter so seemingly inconsistent, the doctor stated, it should be kept in mind that the danger of an electric current depended on circumstances which might be placed in the following two categories: 1. The external: (a) voltage, (b) amperage, (c) number of poles, (d) the time limit of contact, and (e) the kind of current (A. C. or D. C.). The continuous current appeared to be more dangerous than the alternating. 2. The individual: (a) the resistance of skin and body, (b) the path of the current through the body, or over the surface of the skin, and (c) the condition of mind and body. The speaker stated that electric lesions were painless. With regard to the mechanism of death by electricity there was no definite scheme or model. In most cases it seemed like suspended animation. It is an interesting fact that there was between electric shock and death an interim of a few seconds in which the stricken person appeared to be quite in a normal state. By experiments on dogs in the physiological institute of Prof. von Tschermak it had been discovered that the irritability of the brain, which had subsided immediately after a shock, had a few seconds later become re-established, and everything then depended upon whether the action of the heart would be continued or not. As there were sometimes hemorrhages of the brain, and as the pressure of the cerebrospinal liquid was increased, it was necessary and important in cases of first aid to lay the patient with the head elevated.

Largest Induction Coil

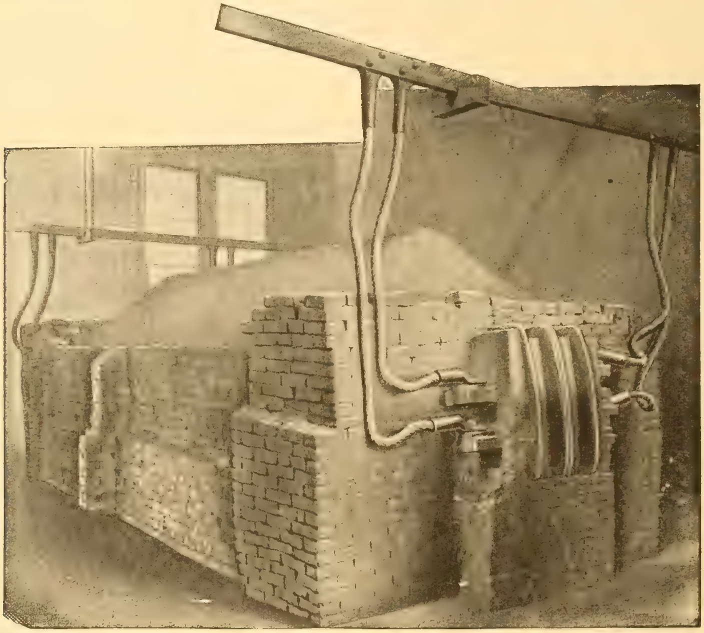
The largest induction coil, hitherto the famous Spottiswoode, is now stated to be a German coil which gives a 50-inch spark, requiring 30 amperes at 110 volts. The iron core is 80 inches long. The primary coil consists of six layers of copper tape, making altogether 792 turns, and the secondary coil contains 100 miles of copper wire about one-hundredth of an inch in thickness.

The Making of Near Diamonds

By GEORGE F. WORTS

Eighteen years ago a chemist while experimenting with an electric current, discovered carborundum. He had a small bowl, such as plumbers use, and into this placed some crushed coke and clay. Into the mixture he thrust carbon electrodes connected to a dynamo. The heat generated by the resistance of the mass, melted the ingredients in the bowl, and when one of the carbons was withdrawn, the trained eye of the chemist detected some minute crystals adhering to it. These tiny jewel-like bits were found to be most gorgeous in coloring and amazingly hard and sharp. The chemist at once thought he had made possible the dream of the alchemists—a man-made diamond. A few simple tests, however, dispelled this theory, but the fact remained that these crystals had wonderful abrasive properties that made them second only to the diamond in hardness and sharpness.

Edward Goodrich Acheson, the inventor, experimented again and managed to collect enough of the crystals to fill a small vial. This tiny vessel, holding the world's entire supply of carborundum, he tucked into his pocket and went to New York. Realizing the possibilities of his new invention as a substitute for diamond dust for jewel polishing, he interviewed several diamond experts, who were so impressed with the qualities of his product that he immediately secured an order. The price paid was 40 cents a carat or $880 a pound or nearly two million dollars a ton. However, the order was only for a few carats.

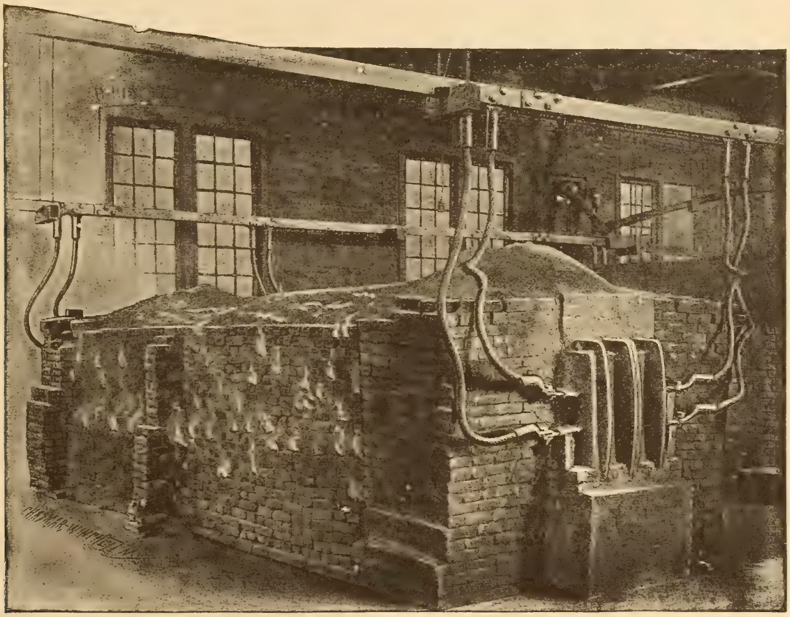


CARBORUNDUM FURNACE BEFORE BURNING

Other industries soon commenced to appreciate the worth of this new abrasive and as the demand increased, the output likewise grew and the price was lowered. Carborundum, today, sells for about 10 cents a pound in grain form. About 10,000,000 pounds of carborundum are manufactured annually.

The process of manufacture is practically the same as it was in the beginning, excepting that everything is done on a greatly enlarged scale by wonderfully improved methods.

Carborundum is a trade name given to carbide of silicon, and carbide of silicon is a chemical combination of carbon and silicon. The chemical transformation is brought about in a most interesting way. The element carbon is supplied by crushed coke and the element silicon, by sand. Accordingly, these two materials are mixed in a certain proportion and packed around a core in the electric furnace. The mixture is made porous, as a preventative of gas formation and explosion, by the addition of a small quantity of sawdust. The carborundum furnace is rectangular in shape, measuring about 50 feet long, seven feet wide and six feet high and built of fire brick. At each end of the furnace is a group of cables about two inches in diameter to carry the large amount of current required to make carborundum. The cables are connected to large carbon rods or electrodes. The mixture of coke and sand being filled in the furnace bed, the current is turned on at about 250 volts and 6,000 amperes. As the temperature of the mass rises, less voltage is needed and it is decreased to 160, but the amperage is raised to 9,400. Thus the actual consumption in kilowatts is practically always the same.

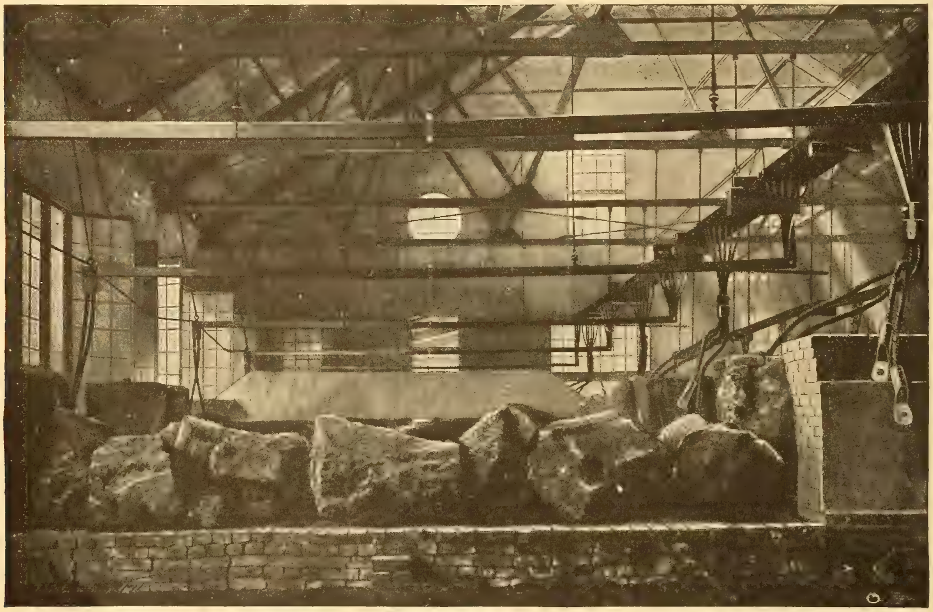


CARBORUNDUM FURNACE DURING OPERATION

The current supply is regulated by auto-transformers. Thirty-six hours are required for the crystals to form. The amount of heat developed in a furnace of this type is terrific and though never accurately measured it is estimated at about 7,000° F. This would readily vaporize steel, granite and marble, and in it the most refractory materials would burn like so much tallow. It is so hot that it is believed that if a person were to look into the heart of a burning furnace he would be instantly rendered blind. Incidentally, enough electric power is consumed in a carborundum furnace to carry the Lusitania half way across the Atlantic Ocean or an electric express train from Buffalo to Salt Lake City.

This, then, is the inferno in which carborundum crystals are created. At the end of the required period, the outer crust is removed and beneath are the carborundum masses that rival the radiance of precious gems. New purples, new greens and golden tints are discovered in every lump, colors which an artist would despair of truthfully reproducing. These crystal masses are taken from the furnaces and crushed into tiny, individual crystals or grains under large steel grinders. The grains thus obtained are carefully washed, then dried in rotary driers and sent to the sifting room. Much after the manner in which flour is bolted are the grains sieved through silk screens into sizes corresponding to emery. The graded grains or powders are then mixed with bonding materials and fashioned into grinding wheels. The grinding wheels are made in molds which are placed in hydraulic presses. The shapes are then placed in kilns and vitrified at a heat of about 2,500° F., after which they are removed, trued, tested and shipped.

The testing of the wheels is a very interesting proceeding. The finished wheels are fastened upon a shaft and boxed in and then revolved at a speed 70 per cent greater than they would be run under ordinary shop conditions. If the wheels are faulty they will break. Very seldom, however, do they fail to survive the test. The testers are required to sign affidavits specifying which wheels they test, the speed and minute details. This absolutely insures the user from danger from "exploding" wheels.

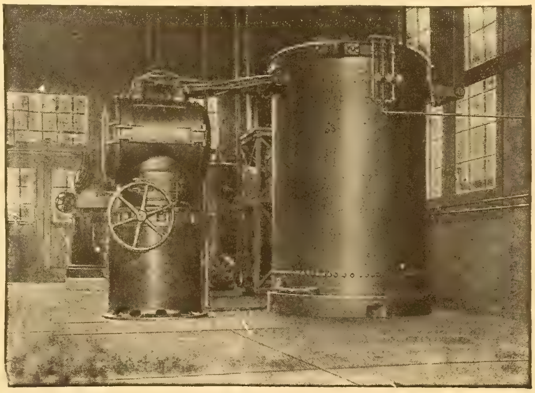


CARBORUNDUM FURNACE AFTER BURNING, SHOWING CRYSTAL MASSES

The abrasive superiority of carborundum over emery is this: where emery grinds, carborundum cuts. It is intensely hard and brittle, not tough. When the pressure of the material to be ground becomes so great that something has to give away the carborundum does not wear down to a smooth surface as does emery, but the grains split and break, thus presenting fresh cutting edges.

A microscopic examination of the metal removed by emery grinding shows little globules which have been rubbed off and melted by frictional heat. A similar examination of the metal removed by carborundum shows little shavings like those removed in turning a locomotive tire.

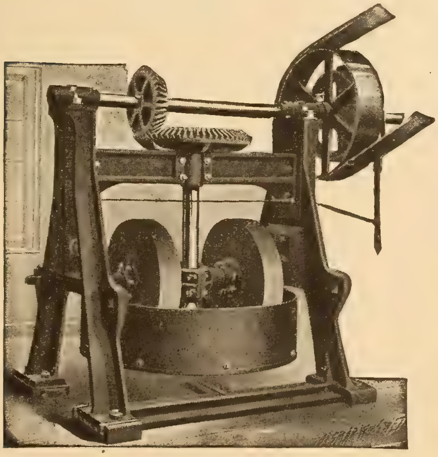
Throughout the entire process of making carborundum, after the crystals have once been formed, they forever remain in a crystalline form. From the coarsest grinding stone to the finest jewel polishing powder that will remain afloat in water a space of 60 seconds, the grains are always crystalline.



A CORNER OF THE TRANSFORMER ROOM

Though carborundum proved very satisfactory as an abrasive material for cutting

TESTING THE WHEELS



CRUSHING MACHINE FOR GRINDING UP THE CRYSTALS

marble, grinding cast iron, tool grinding and sharpening, and in fact in almost every branch of work where abrasives are used, when it came to doing certain kinds of steel grinding it was not satisfactory to certain abrasive users. The Carborundum Company's metallurgical experts, as a result, have produced an entirely new abrasive called aloxite. The details of the manufacture of aloxite are kept secret. It consists principally of fused alumina and is made in a furnace of the arc type. This furnace differs from that in which carborundum is made, inasmuch as the heat of the former is caused by an electric arc, while that of the latter is caused by the resistance of the core and is called therefore a resistance furnace. Aloxite is manufactured from aluminous material and has a hard, tough crystal.

A CORNER OF THE KILN ROOM

The Carborundum Company also manufactures silicon metal. It has been found that the introduction of silicon metal instead of ferro-silicon into steel, has had a threefold benefit, as the silicon metal combines the three qualities: purity, economy, and great deoxidizing power. The introduction of the silicon metal into the casting means the entrance of but a fraction of the percentage of impurities that are found in the low grade of ferro-silicons; its use means practical foundry economy, as the action of the pure silicon is quicker and more pronounced and its wonderful deoxidizing qualities give better and denser castings. A typical analysis of the 90-per-cent grade of their silicon metal is as follows:

Silicon	90.60
Iron	6.70
Manganese	.08
Aluminum	2.35
Phosphorus	.02
Carbon	.22
Sulphur	.00

Ferro-silicon ranks very low in silicon, at times being below the 50-percent grade.

When the Carborundum Company undertook to make silicon for commercial purposes it was being sold for about $4.00 a pound. By careful study they have reduced its cost in the higher grades to about $140 per gross ton. With the perfection of the details of its manufacture and the inevitable increase in the demand for the product, this price will be materially lessened.

The electric furnace in which silicon is made is somewhat similar to the aloxite furnace. It is of the arc type, a square structure lined with carbon and from the top two carbon rods or electrodes are suspended. These rods connected to heavy wires or copper bar conductors send the tremendous heat-producing energy surging into the body of the furnace.

Into the mouth of the big furnace the mixture of crude materials is placed and the power turned on. A terrific arc forms between the two electrodes and drives a 3,000° F., "U"-shaped flame into the mass. At this heat the mixture is reduced to molten silicon and drawn off, not unlike slag from a smelter. For three hours 1,200 horsepower of electrical energy is consumed, reducing 25,000 pounds of crude materials to 8,000 pounds of silicon metal.

About the top of the furnace is built a wooden platform from which the men shovel the crude materials into the opening. The glare from the arc is so blinding that the men are compelled to wear smoked glasses in order to work in this position with any degree of safety to the eyes.

At the end of the required period the workmen climb down and prepare to tap the furnace. In its side is a glowing, red opening into which the workmen thrust a long rod, and instantly, amid a shower of sparks, the thick, lurid stream flows out into a small, clay-lined ingot buggy. This thick, lurid stream is the molten silicon metal. It is allowed to cool and then broken into lumps for convenience in handling by the steel makers or foundry men.

The amount of electric current consumed by the Carborundum works would keep a large-sized city constantly supplied with light and power. The current is delivered from the great plant of the Niagara Falls Power Company.

Making a Magnet Talk

By Robert Grimshaw

The phenomenon of the "speaking arc," in which the carbons of an electric arc lamp can be made to reproduce the human voice, is now fairly well understood. In line with the speaking arc Herr Emil Kosack of Magdeburg, Germany, has made some interesting experiments by which magnets have been made to reproduce speech and musical sounds, and in a different manner from the ordinary telephone. A description of his work appeared in *Die Welt der Teknik* and is of considerable interest.

Kosack did not confine himself to researches with magnetic circuits, but made experiments with bar magnets, and was able to get therefrom quite good reproductions of speech.

In one form of his apparatus an iron core is provided with two coils, one of which is connected with an electrical source and the other with the circuit of a microphone and battery. Fig. 1 shows this arrangement, the coil which is connected with the microphone being plainly seen. Further, Kosack showed that even when the electromagnet is unexcited, a telephonic reproduction is possible. The very weak results in this case may be strengthened by laying on the end of the bar magnet a plate of sheet iron or other material. This plate then takes part in the vibrations. In this way any piece of iron or steel may be made to reproduce melodies. This arrangement is illustrated in Fig. 2, in which there is shown a core with a coil connected to the microphone, and a reinforcing or resonance plate.

Kosack also noted the interesting fact that the coil which is in connection with the microphone circuit is influenced by the microphone currents even when the iron core is not present, so that melodies may be reproduced thereby with great clearness. But the volume of sound is naturally much less, so that the hearer must hold the apparatus close to the ear, as shown in Fig. 4.

By using iron wire instead of copper a better result may be obtained. The vibrations caused in the coil are supposed to be derived from an electrodynamic effect between the separate turns of the bobbin, although there is reason to believe that molecular action in the interior of the wire plays a role. In any case the vibrations between the separate turns are so slight that a bobbin bedded in a pitch-like material gave just as good tones as one which was not similarly bedded. Here, also, the effect is considerably increased by the use of a plate-like object as reinforcer. As even quite thick plates may be used, there is evidently no membrane-like effect as in the telephone.

The remarkable increase in the loudness of the tones may be ascribed to the fact that by reason of the increase in the surface of the plate, the diameter of the vibrating air column is also increased.

Making use of these discoveries, Kosack has been able to construct a telephone receiver without iron and of remarkable simplicity. This receiver consists essentially of a wire coil wound either free or on a spool, and mechanically connected to a plate which may be extended to a funnel. The tones are thereby given with extraordinary clearness and distinctness. Switching in an induction coil between the telephone and the microphone makes no difference in the excellent operation of the device. As this telephone may be constructed without any iron at all, it may be used where iron would be attacked by acid vapors. Fig. 4 shows the new receiver in use.

While the well-known Bell telephone, the simplicity of which is proverbial,contains three more essential parts than the Kosack apparatus, (a magnet, a wire coil and an iron membrane) and the Peukert apparatus consists of two parts (a magnet and a coil) the above described Kosack receiver consists, aside from the necessary resonance plate, of only a coil.

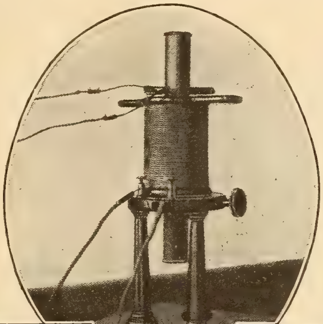


Fig. 1. Iron core with two coils

Fig. 3. Receiver constructed without iron

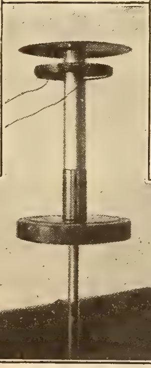


Fig. 2. Plate of iron made to vibrate

Fig. 4. Reproduces melodies clearly

Looking Through Metals

Very thin films of some metals become transparent at heats not nearly sufficient to melt them. For instance, if we take a sheet of gold leaf somewhat thinner than the paper on which this is printed and heat it by an electrical current to temperature of about 2,400° Fahrenheit, it will become as translucent as a pane of green colored glass. If carefullv kept away from drafts, very much finer sheets of gold leaf can thus be heated by clamping them on frames of marble or slate and applying the current through the metal strips which clamp each end of the sheet. When this is done with gold leaf of about one hundredth the thickness of this paper and the current is gradually increased until the temperature reaches 3,000° Fahrenheit, the leaf becomes not only translucent but also transparent, so that it is actually possible to see through it. For apparently the same reason silver foil, which only requires 2,250° to make it clearly transparent shows a bluish-violet tint. Copper foil has also been made transparent in this way but remains so only for a short time as it combines with the oxygen of the air when thus heated and the resulting compound is not transparent.

In planning to keep in touch with his crew even when 20 or 25 miles from the same during his coming antarctic expedition, Capt. Scott is taking with him a telephone outfit including a supply of aluminum wire but no insulators. The wire will simply be laid over the ice and snow which are dry enough to give the needed insulation.

Making and Testing Telephone Cable

By WALDON FAWCETT

Of all the industrial activities identified with the electrical field, the one to which, considering its importance, the least thought is usually given, is that which embraces the manufacture of telephone cable. And yet this class of cable, in its present highly perfected form, has not only been essential to the development and extension of the modern telephone system but the industry in sheer point of magnitude of output is one of the most important in the whole electrical field. Incidentally it is gratifying to the patriotic pride of Americans that in this, alike to most other sections of the telephone realm, almost every important step in the evolution of the product has been attributable to Yankee ingenuity and skill and the manufacturing processes now employed in our up-to-date cable manufactories are accounted distinctly in advance of prevailing practice abroad.

The credit for evolving telephone cable, as we know it today, does not belong to any one individual in the same degree that personal achievement has been recognized in the case of certain other electrical essentials. The idea of the underground telephone cable seems to have had its inception in Philadelphia in 1881, but one of the very first of the experimental cables was tried out in Boston. This was simplicity itself, consisting merely of two parallel rubber-covered wires. However, it was speedily demonstrated that this form of construction gave such large electrostatic capacity and self-induction that one mile was the limit of a telephone connection.

Experiment for improvement began at once and the self-induction was reduced by twisting the wires together—an expedient which increased the usefulness of the cable. However, the electro-static capacity was still so high that only a very limited amount of this type of cable ever found its way into use.

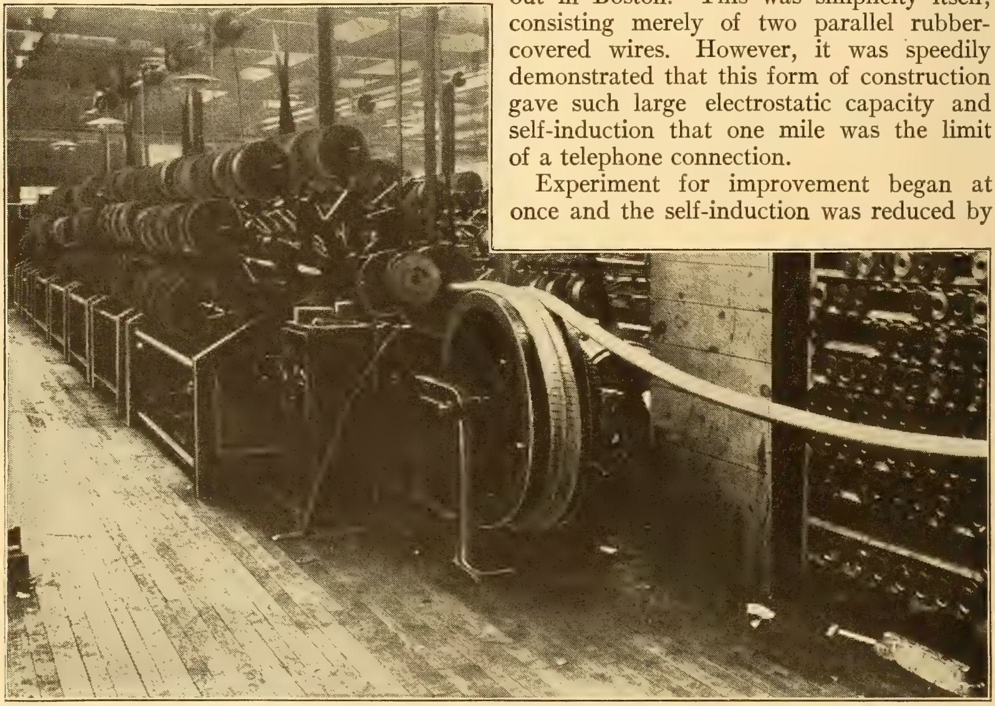


FIG. I. CORE MAKING MACHINE

Obviously the root of the trouble was to be found in the high electrostatic capacity of the insulating medium and therefore there ensued an earnest quest for an insulating material that would give a low electrostatic capacity. It was only after a long interval of random experimenting that Mr. W. D. Sargent of Brooklyn finally gave the investigators the right trail by his experiments with dry paper.

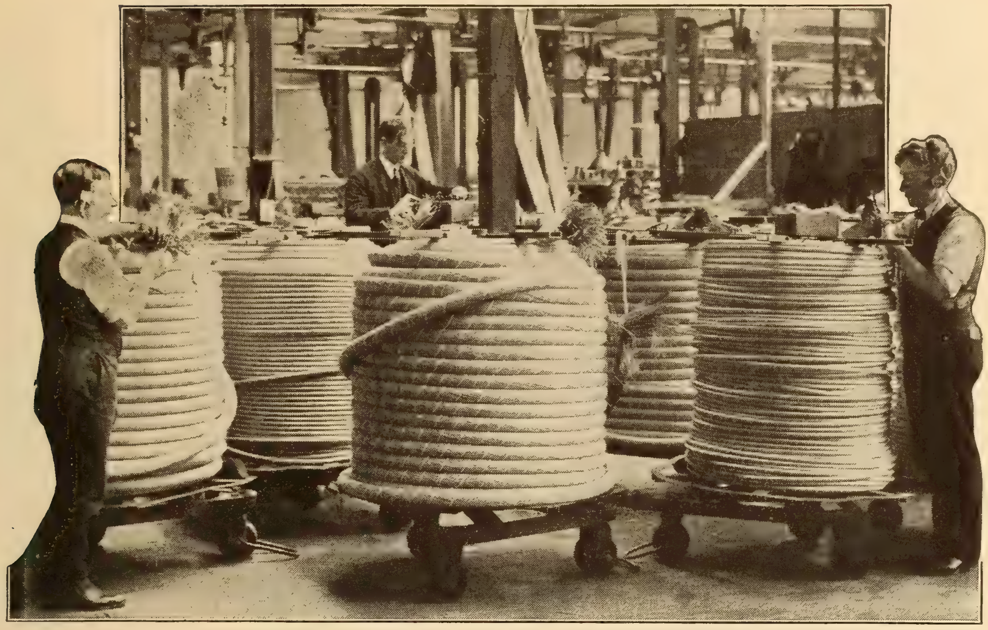


FIG. 2. TESTING CABLE CORES

Soon after this Mr. T. D. Lockwood discovered that the low capacity depended not upon the insulating medium but upon the dry air included in the loosely wound paper, but even then it became necessary to find some cheap and effective means for protecting the dry paper insulated wires from moisture and mechanical injury. The credit for the solution of this latter problem seems to belong to Mr. W. R. Patterson who not only evolved the first device for sheathing the cable in lead but also invented the hydraulic press which is, to this day, depended upon for this portion of the work in all large factories.

As the development of the standard type of telephone cable has progressed it has been found necessary to exercise more and more care as to the quality of the raw materials entering into the manufacture and upon which the life and usefulness of the cable is so largely dependent. Especially is this true in the case of bare copper wire which must not only be of high quality but must be handled with extreme care to avoid injury, a slight abrasion upon the surface of the wire being sufficient materially to decrease its strength at the point affected. The result of these exigencies is that in every cable manufactory there are regularly employed chemical and electrical experts.

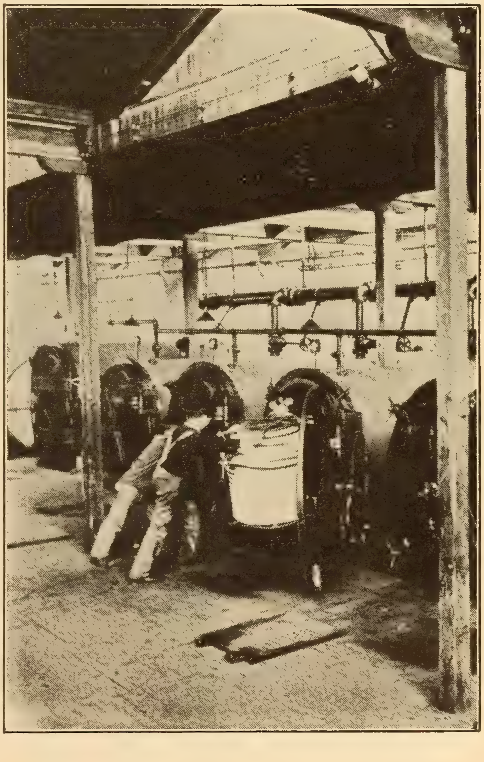


FIG. 3. FILLING ONE OF THE DRYING OVENS WITH CABLE

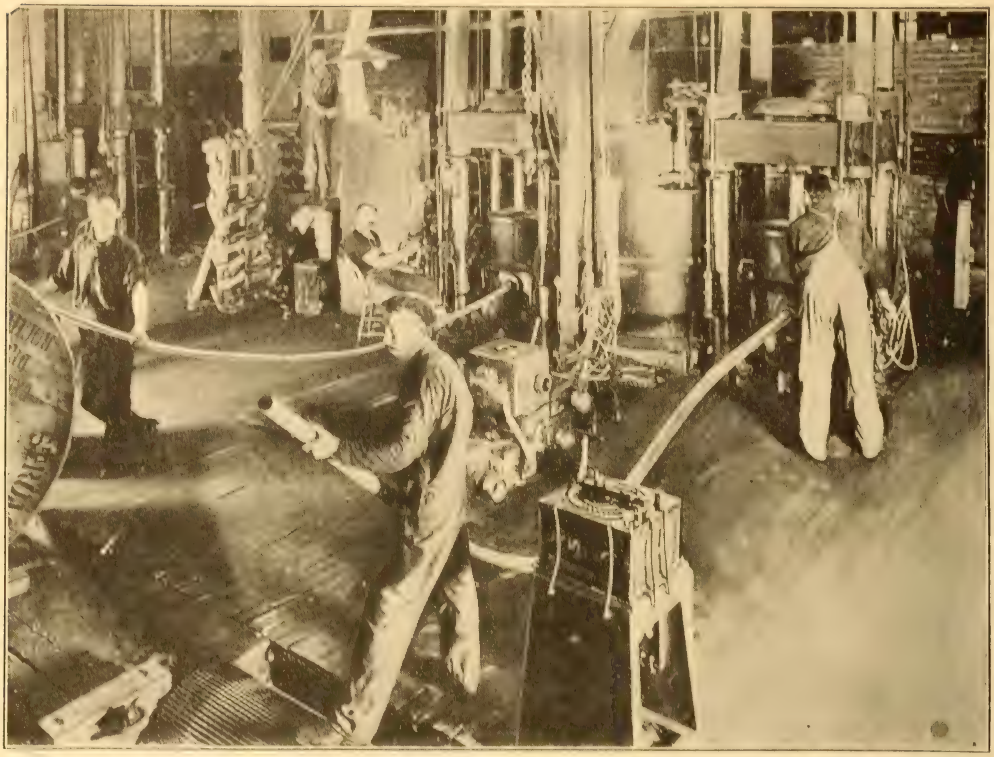


FIG. 4. FINISHED CABLE COMING OUT OF THE LEAD PRESSES. THE LEAD JACKET IS SMOOTH AND CYLINDRICAL, WITHOUT A SEAM

In the actual manufacture of telephone cable the first operation is the insulating of the single conductors. Three or four different standard sizes of copper wire are commonly used in cable manufacture and this wire which is pure, bright, annealed copper, with a conductivity of at least 98 per cent of that of pure soft-drawn copper, is fed from coils into horizontal machines. Special unreeling drums are employed and the wire upon leaving these passes through two heads set in line and revolving in opposite directions. Each of the heads winds one wrap of paper spirally on the wire, thus producing a double wind of paper so arranged that at every point four thicknesses of paper intervene between the wire and the outside of the insulation. The delicate part of this operation lies in the joining of the wires. This is done by experienced braziers who employ pure silver solder, thus insuring a joint that has a lower resistance and also a greater breaking strength than the wire itself.

FIG. 5. TESTING NEW-MADE CABLE—IN THE LABORATORY

In the process of insulating the wire as above described the machines are so arranged that one-half of the wire received

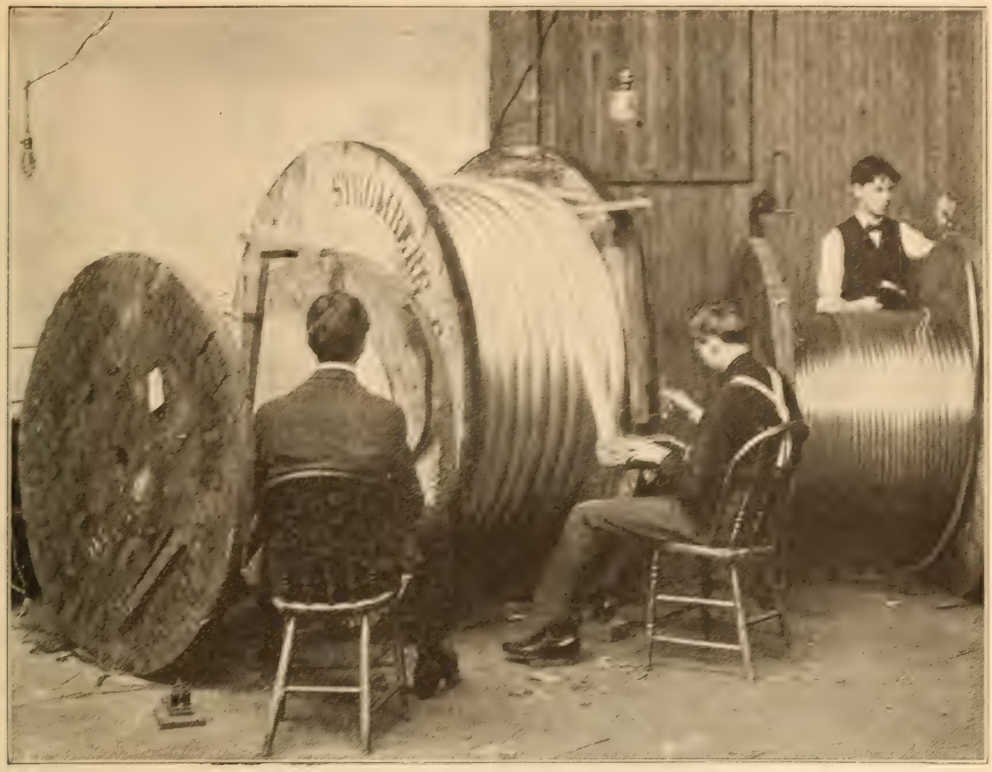


FIG. 6. TESTING CABLE. THESE MEN MAKE THE CONNECTIONS AT THE ENDS OF THE STRANDS

two wrappings of gray paper while the other half of the wire is wrapped in paper of a red hue. This distinctive color scheme is of advantage in the next operation which has as its object the twisting together of the two wires to form a pair. The wires after being twisted go to the core machine where they are "laid up" in the form of a cable core, as shown in Fig. 1. The core machines consist of series of drums on the periphery of which are spindles to receive the spools of twisted wires. The pair of wires on each drum are led through a mouthpiece in the forward end of the drum and thence into the rear of the drum immediately preceding it, the operation being repeated through the entire series of drums. The drums revolve simultaneously but in opposite directions—that is, alternate drums revolve in one direction, and intermediate ones in the other direction.

Inasmuch as each drum places one layer of pairs of wire on the cable, it results in the assembly at the end of the last drum of a cable core which has alternate layers of the conductors put on in the one direction and intermediate layers in the opposite direction. This construction gives the desired non-inductive core and after the final layer of wires is in place the whole core is wrapped with one thickness of heavy manila paper which not only insures high insulation between the core and the sheath in which it will later be enclosed, but also affords some protection from mechanical injury.

Before this portion of the work is pronounced complete the cable core is thoroughly tested for "opens" and "crosses." This is done through the instrumentality of a telephone head receiver and two dry cells. Every individual wire is tested as shown in Fig. 2 and steps are at once taken to remedy and repair any flaws disclosed by these electrical tests.

The next step in manufacture is the drying of the core—a very delicate operation, requiring the constant supervision, day and night, of an experienced man. Indeed, this might be denominated the most critical process in the manufacture of cable, since both high insulation and low capacity in the finished cable are dependent upon it. The drying is done in the large ovens shown in Fig. 3, each of the iron chambers of which is capable of holding thousands of feet of cable core. After the heavy iron door of one of these ovens has been closed on a quantity of cable core the temperature of the chamber is raised by the manipulation of outside steam valves. When the core is deemed to be sufficiently hot a vacuum pump is started and the air and moisture pumped out of the chamber. Pumping continues until the core is perfectly dry, after which the vacuum is broken by the admission of dry air which is absorbed by the cable core.

Now comes the encasing of the core in its lead sheath, one of the most important of all the processes and one that is especially interesting because of its dependence for success upon a peculiar physical property of lead—namely its ability when highly heated to assume a plastic state if subjected to enormous pressure and to become solid again as soon as the pressure is removed. On this principle melted lead is placed in the cylinder of a machine shown in the back-ground of Fig. 4, known as a lead press and when it has cooled to 75° or 100° F. below the melting point, is put under pressure and forced around the cable core which is fed into the press as needed. As the cable core emerges into the open air with its plastic coating the lead quickly assumes a solid state and thus there is provided a continuous sheath around the cable.

The cable as it comes from the lead presses is wound direct on the large wooden reels on which in due course it will reach the "ultimate consumer." First, however, it must be allowed to cool to about 60 degrees and then pass muster in a final inspection consisting of tests for insulation and capacity by means of highly sensitive reflecting galvanometers in the laboratory shown in Fig. 5. These instruments which are brought into play in turn upon each individual wire in the cable under inspection, are located in a room carefully shielded from vibration. The connections for the various sets of instruments are made as shown in Fig. 6 by men stationed outside the room where the testing is done and all communication between these men and the men in charge of the instruments inside must be carried on by means of telephones and telegraph sounders. The outcome of the test of each cable is determined, of course, by comparing the deflection of the cable under examination with that obtained from a known and certified standard.

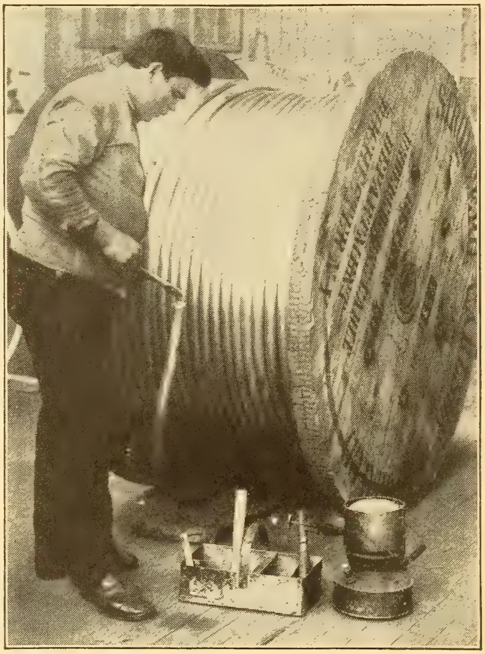


FIG. 7. SEALING UP THE END OF A TELEPHONE CABLE

This brings us practically to the end of the evolution of a telephone cable. It only remains after the cable has been tested and passed its final inspection, to cut off the test end, which to the amount of two feet has been allowed on each length of cable when the core was made to allow for the practical demonstration at the factory. The ends are then sealed as in Fig. 7 with solder and bound securely to the sides of the reel with wire. It has been found that this precaution is essential, lest loose ends play havoc during shipment.

Finally the lags are bound securely with layers of twisted iron wire that completely encircle the reel along its ends and thereupon the reel, resplendent in its new shipping tag, is ready to be rolled into a waiting railroad car enroute to an underground resting place in any city in the country.

Electric Block Signaling

By SIMON DEUTSCH, E. E.

PART I.

How many of you who have traveled on trains, or walked along railroad tracks, and noticed the signal blades and lights bobbing up and down, know how these various forms of signals operate, and what the different colored lights and positions of the blades mean, and what an important part these same signals play in safeguarding your life and the lives of others? But very few, is the answer, even among those electrically and mechanically inclined.

This may seem strange, especially as the art of electric signaling is not only intensely interesting, but is comparatively young, when compared to the time and development devoted to other special branches of the electrical field.

Men in the employ of railroads became signal experts by necessity, building crude apparatus in the railroad shops, or contracting with some jobbing shop to make up the required apparatus from drawings and explanations furnished.

And so in years both the railroad men and the builders learned to see and fulfill their needs, by co-operating with each other, and today we find the positions of signal engineer, signal supervisor, and signal inspector filled by young men who are graduates from this school of practical experience and the small shops which started in so small a way but very few years ago.

Because of this silent though swift development all taking place in a little family, as one might say, but little has been published as yet on this important subject, even though at the present time it is fast becoming a study for the specialist, just as has the telephone, wireless telegraph, electric lighting and other comprehensive branches of the electrical art.

It is therefore only reasonable to assume that under these conditions railroad and signal companies are now looking among the ranks of the specialist to supply the demand for these talents, and with such search is beginning a period of general enlightenment on this subject.

DEVELOPMENT

The successive stages through which the art of signaling has been forced by necessity, and which finally resulted in the developing to the present efficient stage, the various systems of electric block signaling, are most interesting, and should be carefully followed.

It can readily be appreciated by the reader, that if a railroad company operates only one train a day between two points, no system of spacing, or giving of train orders, would be required.

As soon as more trains are put into service between these two points, and on the same stretch of track, a system of spacing is required to avoid collisions, and sidings have to be installed, so that meeting points can be arranged for trains to pass each other. And if trains run both ways on the same track, it is necessary to give protection from head-on collisions by blocking. In other words, some system must be installed to tell the engineer of one train that the other train has the right of way, and that he must take the siding. This information is conveyed and indicated either manually, half manually and half automatically, or entirely automatically.

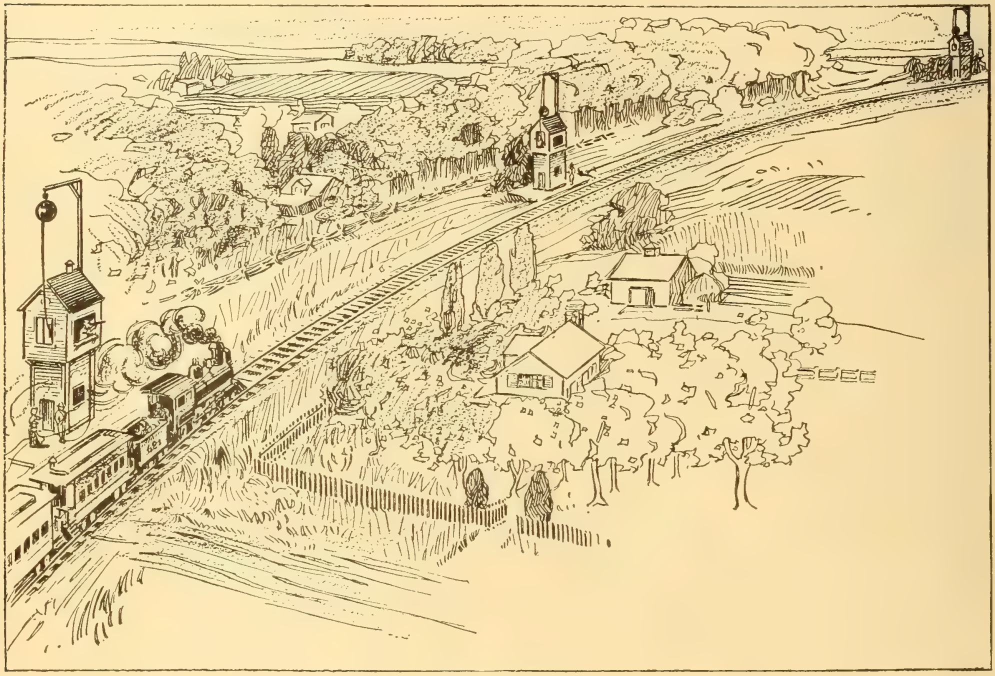
The need of absolutely positive and reliable means for safely and economically handling a great many trains over a given section of trackway has brought about remarkable developments, and as is usual, electricity was turned to for meeting the requirements.

We all know the important position the telegraph holds in railroad work, although even now it is fast being displaced by the telephone. But long before the telegraph was even dreamed of, trains were running, and it was necessary to arrange for the proper handling of them.

In England stations communicated with each other by means of a large ball, raised and lowered on a high mast, which was erected at every station having an attendant. When a train left a station the ball was raised to the top of the mast and the attendant at the next station, which for convenience we will call Station No. 2, could thereby tell that a train was approaching, and signal to the station the other side of him, Station No. 3. When the train reached Station No. 2 and was ready to leave there, the attendant at that point would raise the ball to the top of the mast, and the attendant at the first station, or Station No. 1, would lower the ball to half mast. Likewise, when the train was ready to leave Station No. 3, the ball at Station No. 2 was lowered to half mast, and the attendant at Station No. 1, seeing this, would lower the ball at his station to the ground. Thus we see the first beginning of the block signaling system.

Of course, no reliability could be placed on such a system, as too many things could interfere, such as fog, sickness of attendant, forgetfulness, etc.; and the system was therefore acknowledged as unsafe.

Then came the inventing of the telegraph, which was hailed with joy by railroad managers, and with it came the establishing of block stations with telegraph operators in attendance, the operators communicating with each other as to the location of trains, the kind of signal to display, orders for trainmen as to meeting points, etc. Where the traffic was heavy, these stations were placed close to each other, so that trains could follow each other more closely. This system of controlling train movements by telegraphic communication is still in use on many railroads, especially between points having but few trains a day. Although this system has decided advantages over the mast and ball system, or for that matter any system depending entirely on the eye, it was found that operators grew careless and that it was necessary to provide some means to prevent them from letting a train onto a certain section of track, or block, as it is called, before finding out whether or not the block was clear.



THE FIRST BLOCK AND SIGNAL SYSTEM AS USED IN ENGLAND

The lock and block system, which is a system requiring the co-operating, at the same time, of the operators at each end of a block, before a clear signal indication can be displayed, was designed to overcome the faults of the systems described above. Code bells, telephones and telegraph were installed between stations for communication. Mistakes, however, were still made, and always will be made, where the human being entirely controls the displaying of signal indications. It was found that operators would not co-operate with each other and would set certain signals at the wrong time. These mistakes occurred so often that other protective means were sought; which finally led to the development of the controlled lock and block system.

As the name indicates, this system included the control of the signal indication by the train itself. The first introduction and application of track rails carrying and controlling a part of a signal circuit, was made in the installing of this system, which makes it impossible for the operators to display a clear indication, while a train is between the two stations.

The objections to this system is that only one train is allowed in a block at one time, and where the blocks are long, trains are spaced too far apart. To bring the stations closer, makes necessary more stations and operators, which again adds heavily to the operating expenses of the railroad company. Then again, all of the systems described above require attendants who first have to establish communication between each other, which is none too fast a process, and which is open to errors, and with the enormous increase in traffic is not sufficient to handle trains rapidly or safely enough.

The automatic block signal system is a system that does not require attendants for the actual operation of the signals, other than to maintain the mechanisms and wiring in good order. The signals operate by means of gearing and motors, magnets, or electric lights, controlled by trains using the track which the signals govern. Signals will show "clear," which means "proceed," providing there is no other train, no open switch, or broken rail in the block at the entrance of which the signal is placed.

The signal will show "danger," which means "stop," as soon as the front part of the train passes the signal, and will stay in this position until the train has passed out of the first or second block ahead, according to the spacing desired, after which it will again show "clear" for following trains.

Editoral Note—This is the first of a series of articles by Mr. Deutsch, who will undertake in everyday English to explain how electricity is used in the signal system of a railroad. In the next and succeeding chapters illustrations will be shown of the different types of electric signals now in use on the most prominent railroads, and explain just what the position of the blades in the daytime and color of the lights at night mean to the man in the engine cab.

ELECTRICITY

From the infinite space of a sphere unbound,
Where the arches of the universe span;
Where the elements clash and the storm clouds roll,
I come as the servant of man.
With the speed of the wind I answer his call;
I bring him a message without delay;
He can hear the sound of a well-known voice
Though a hundred miles away.

Weary and worn, with lagging feet
The traveler who journeys afar
Would faint by the way ere he reached his home,
Were it not for my swift-wheeled car.
When dread disease racks the human form,
And baffles the surgeon's skill,
I send my rays through tissue and flesh,
And he uses his knife at will.

When storms range wild on the trackless main,
And the thunderbolts I hurl
O'er the billowy deep of a surging sea,
Where the foam-capped breakers curl,
The ship that swerves from her wonted course
In that black and starless night,
Would dash on the deadly wave-swept rocks
Were it not for my searching light.

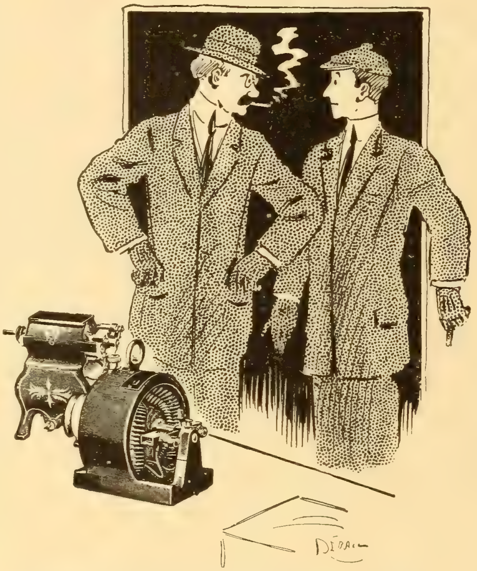
I fashion the bands for the cannon's throat,
And give edge to the keenest steel,
I gild the chain that my lady wears,
And polish the engine wheel.
My light gleams forth from the highest tower,
And down in the deepest mine;
The banquet hall and prison bars
Alike in its radiance shine.

—Renice Radcliffe.

Talks With the Judge

DYNAMOS AND MOTORS—THE DIFFERENCE

"What is the difference between a dynamo and a motor?" said the Judge one day as he was fussing around in an electrical supply store trying to tell the salesman all he didn't know about igniters and spark plugs for automobiles. We had become interested in looking over the general stock and a fine line of small motors had attracted his attention.



What's the difference between a dynamo and a motor?

"Thousands of people ask that same simple question every day," I replied. "I say simple, because to anyone who understands electricity it is one of the very A B C's. Yet, strange to say, the majority of the people who are living in this Age of Electricity have never taken the trouble to even find out the difference between a dynamo and a motor.

"To explain in the simplest language I can employ, a dynamo is a machine driven by mechanical energy which converts that mechanical energy into electricity—another form of energy. A motor is a machine that takes the electrical energy generated by the dynamo and converts it back again into mechanical energy. And curiously enough, the two machines are almost identical in their construction. Indeed some dynamos can be operated as motors and some motors as dynamos without any change whatever.

"It isn't so strange, therefore, owing to the similarity of the construction of these machines, that you hear some one remark, 'And the dynamos under the street car just hummed,' or 'the great motors in the power house revolved at tremendous speed,' not knowing that he had exactly reversed the meaning of the words.

"Going a little more into detail, a dynamo, or a generator, as it is now more commonly called by electrical men, is a machine consisting of what is called an armature which is made to revolve between the poles of a magnet or group of magnets. The armature contains a great many loops of wire which cut the lines of magnetic force which flow from one magnet pole to that of opposite polarity. Although no one can see how it is done, it is nevertheless true that this simple process causes a current of electricity to flow through the wires of the armature, which may be led out of the latter through suitable sliding contacts or brushes and sent out through the conducting wires of a circuit which may extend many miles. The current is supposed, for convenience, to flow out over one wire and back over the other, keeping up a continuous flow through the armature and outside circuit.

"There you have the dynamo. To operate the dynamo mechanical energy as that of a steam engine or water wheel is required. The more current you take out of the armature the harder it is to turn.

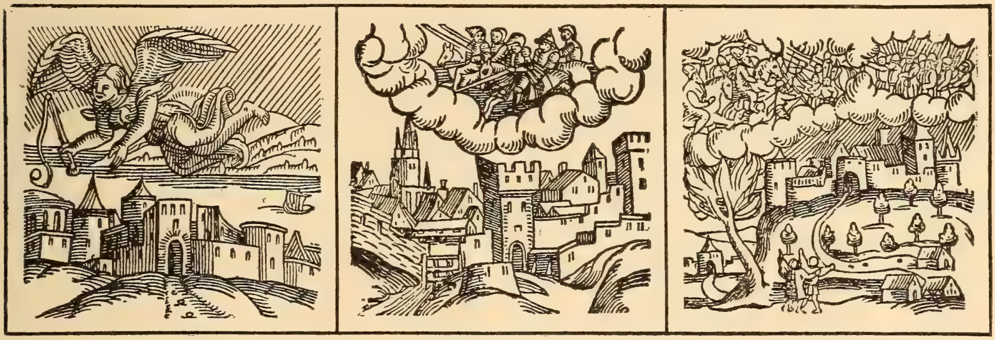
"Now if you take a machine similar to a dynamo away out somewhere on the line and connect its terminals to the two wires of the circuit, the current which is being generated by the dynamo flows through the armature of this second machine and, lo and behold, the armature begins to spin. There you have the motor, which is nothing more than a dynamo running backwards and using up current instead of producing it. Put a pulley on the shaft of the motor and you get mechanical power again, which is what you started out with. That is why motors are so economical and convenient where mechanical power is required. Great dynamos in a power station generate current in vast quantities which is sent out over the lines to be used up in motors of all types and sizes from a thirty-second of a horsepower up to a thousand horse-power, as desired. Now when you want to operate a sewing machine by power you buy a little motor to do it. A few years ago it would have been necessary for you to put in a boiler and steam engine."

Non-electrical Conceptions of the Northern Lights

Only during the last decade has it become generally known that the beautiful phenomenon which we call the Aurora Borealis in the northern hemisphere and which those living south of the equator call the Aurora Australis, is an electrical manifestation. Today it is universally admitted that this beautiful luminous phenomenon is the result of a discharge of electricity through the rarified aqueous vapor in the cold air.

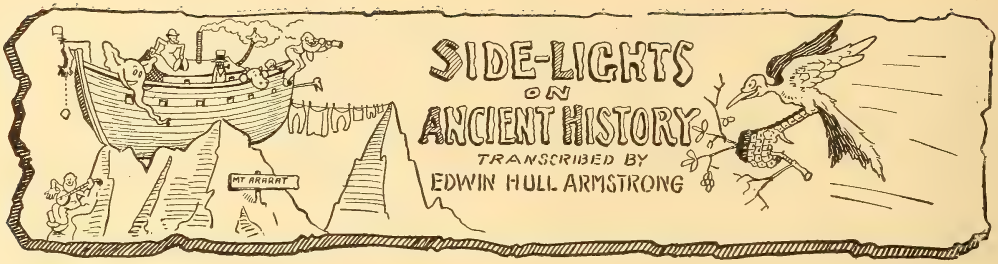
Nowadays the appearance of this interesting display at the point in the sky towards which the magnetic needle points, usually comes as a pleasant surprise. But in earlier times these northern lights (like the less frequent appearance of comets) were looked upon as manifestations of the supernatural and generally as omens of some impending calamity. Some of the rare books issued three or four centuries ago show some of the old conceptions of the northern lights, the earliest being that of a winged witch with a whip, hovering among the clouds and threatening dire vengeance. A century later the popular notion changed to that of battling warriors.

Nor has this superstitious dread been entirely outgrown to this day, since those looking for mishaps can always find some early event to link to such a premonition. Hence right within our own time thousands, if not millions, have held a superstitious fear that dire happenings would follow any generally visible manifestation of the polar radiation, not understanding that this is just as natural a sequence of certain weather conditions as is the appearance of hail or sleet. For instance, an unusually brilliant aurora was visible in most of Europe on the 24th and 25th of October, 1870, when the war between France and Germany was at its height. Two days later the city of Metz capitulated to the Germans and 173,000 French soldiers were taken prisoners. The superstitious among the French were never more sure of having a great misfortune foreshadowed by an aurora; but how about the equally superstitious German peasants who had seen the same sign? Still more speedy was the apparent sequel to the aurora of September 9, 1898, for twenty-four hours later the Austrian queen was assassinated. And if instead of Halley's comet an unusually attractive aurora borealis had been visible in England early in May of this year, it would undoubtedly have been connected by many with the unexpected death of King Edward.



ILLUSTRATIONS CONTAINED IN BOOKS THREE OR FOUR CENTURIES AGO, SHOWING EARLY CONCEPTIONS OF THE ORIGIN OF NORTHERN LIGHTS

Truly, the suppression of superstition is a slow process as long as every week brings one or more important mishaps somewhere on this great globe, any one of which can easily be linked to a misconception of that most beautiful of all meteorological phenomena, the so-called northern light.



SIDE-LIGHTS ON ANCIENT HISTORY

TRANSCRIBED BY
EDWIN HULL ARMSTRONG

It was demonstrated yesterday that hens will lay at any hour in electric lighted apartments. Ham has kept the electric lights burning continuously in the hennery and as a consequence the hens lay any old time, day or night. It is not unusual for a biddy to jump off the nest and give a series of hysterical cackles at midnight.

The other morning Noah arose at two o'clock and began to build a fire. When informed of the hour he said he thought it past sun-up as he had heard a hen jump off the nest and cackle.—*Ark Record.*

◆

"What time is it, Hammy," asked Noah, as a particularly dark cloud turned day into night.

Ham looked at his watch. "It is just 12 o'clock, father," he said. Then, as he took a step or two in the direction of the dining room, he stopped, took out his watch again, shook it and looked puzzled. "It's running all right," he said, holding it to his ear. "But I would have sworn it was just the same time four hours ago." It stayed 12 o'clock for three days, the watch running all the time. Then the truth became known. It had been magnetized by "stray magnetic field" surrounding the eel tank.—*Deluge News.*

And to this day, because of this incident, we are uncertain just when dinner time really occurs, preferring, as we do, to yield to the dictates of our stomach rather than the record afforded by our office clock.

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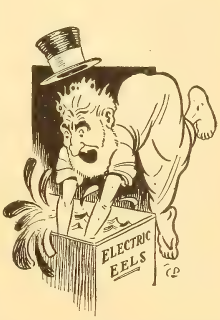


He made directly for the eel tank

Noah came out of the kitchen with his sleeves rolled up. He made directly for the eel tank under the impression that it was the place where the catfish were kept. Plunging his arm into the greenish water up to his elbows he fished around for a moment, when with a roar of pain he withdrew his hand and started back to the kitchen on a trot, holding the injured member in his other hand.

"Shades of Leyden jars," he muttered as he stumbled along, "why couldn't I have remembered that those were electric eels. It said plain enough on the bill of lading—'10,000-volt eels, for perpetuation purposes only.' They feel like trolley wires." With which remarks he gazed up again wearily at the dripping sky.—*Ark Record.*

Among the forms of disorder from which Noah hoped to escape by the Ark voyage was the old style method of celebrating the Fourth of July. The following from the *Deluge News* speaks for itself:

Fifty-fifth Day:—Gauge above low water mark of Adam's time 3500 cubits.

It was on the evening of the Fourth. Noah's strict instructions that the children should have no matches had been religiously obeyed. The old saint was overjoyed and was telling the children (all but one) of the accidents that formerly had followed in the wake of the popular celebration. He had drifted from that to commending them on their obedience, when a series of shots, booms and other loud reports rent the humid atmosphere at the front of the vessel. With that the youngsters made for the lower deck, and Noah, his faith in humanity greatly shaken, followed.

The whole trunk full of fireworks which were being saved to celebrate any possible future landing of the Ark had been exploded.

"Where's that Shem boy," suddenly exclaimed Ham's wife. That was enough to start trouble and they looked him up. He was a mere child of 63 but he was what is called an amateur wireless fiend. All day long he had been flinging C. Q. D. calls out from the roof of the Ark—only toward evening he had bethought himself of his new relay which he contemplated exploding mines and blasts. Of course he tried it on the fireworks with the result that the younger element were extremely peeved over the loss of the only fireworks in existence.

The whole trunk of fireworks exploded

◆

City Marshall Murphy brought in a battered specimen yesterday. He had been trying to beat his way to Orchard City on the electric suburban. Investigation proved the man to be Cain who has been strictly up against it since his parents had to give up their home in the old Garden. Previous to that time, Eve would occasionally hand out an apple pie or some dumplings to her unfortunate first born when he came home from some long pilgrimage to Egypt or Ethiopia.

It appears that Cain got a job with the First Parents Electric and Railway Company, that is im proving the old Garden of Eden, but as soon as his identity was disclosed they let him go. For our part we think Cain has had the ragged end of it. The affair of his brother's death, in which he was involved, and in which he hardly had a fair trial, no doubt was an accident.

In this connection it may not be amiss to say that this proposed trip of Noah and his family in the Ark, with all the rest of the world at the bottom of the deep is a mighty clear case of favoritism.

When will the people awaken to their wrongs?—*Serpent's Hiss* (Socialist).

◆

Fire broke out in No. 7 trundle bed on the night of the 29th day.

Noah was just retiring when he said: "I smell smoke."

"The children are all in bed," said Ham's wife, with assurance. There was always a disposition to look to the children in case of trouble.

A few smothered cries from below, and a couple of childish forms appeared on deck enveloped in flames. For a few moments all was confusion. Then with great presence of mind Ham soused both youngsters in the eel tank, to the accompaniment of frantic yells.

A couple of childish forms appeared

"It was so chilly," said Ham's wife, after the fire had been extinguished and the youngsters quieted, "that I put the children between the electrically heated blankets."

"What, those electrotherms?" said Noah, "I guess there must have been a short circuit in them. Where did you buy them, Agnes?" turning to Shem's wife.

"Oh, from one of the department stores," she replied. "I saw an ad. in the last Sunday paper before we sailed. It seemed that the store management was somewhat unsettled over the talk of New Nationalism and were cutting prices awfully. I couldn't resist, especially when they told me the electrotherms could be regulated to three degrees of heat."

"Evidently the third degree meant combustion in this case," said Noah as he turned down the light and put the cat out.—*Deluge News.*

◆

The local Fruit Growers Association in conjunction with the railway company gave a picnic yesterday in the old Garden of Eden. It was the first glimpse the public has had of this world renowned orchard.

The place shows the effect of neglect. Four hundred years makes quite a change in things. The cottage inhabited by Adam and Eve is badly shattered. It needs paint and should be reshingled. The old shed kitchen where Eve did her washing, is the best preserved of all. There is a nail at the side of the house where the clothes line was tied, and Adam's fishing rod stands leaning against the house.

The gathering was made memorable by the presence of Adam himself. The old man is well past nine hundred but his memory is still alive to the stirring events of four hundred years ago. As Adam was expelled from the garden it was necessary to procure a permit before he was allowed the freedom of the grounds. Our reporter had no trouble in persuading Secretary Robbins to issue the permit.

Adam states that just previous to the time that the incident occurred he was making a series of electrical experiments to determine if there were any such things as eddy currents. Having need of a high resistance material, Adam induced the Serpent to allow a few of his coils to be introduced into the circuit. When the current was turned on the Serpent boiled inwardly, not only from indignation but also from C2R loss within his folds. When his extremities were taken out of the binding posts he at once set about using his influence to have Adam and Eve expelled.

The distinguished visitor viewed the scenes of his former activities with greatest interest. Once, when the attention of the reporter was directed elsewhere, Adam stole a glance at the tree of Forbidden Fruit, which since the expulsion has been enclosed in an iron cage. As the old man's gaze rested on the ripe, luscious fruit, a dreamy far-away look came across the fine old countenance and an unwonted glimmer into the dim old eyes, and he smacked his shriveled lips reminiscently. The action was momentary and involuntary—the memory of a sensation. The fact of the matter is that the doctor has advised against fruit of any kind for the last hundred and fifty years, and as to apples: after that unfortunate affair of the Garden, the Doctor never would consent to Adam eating any more apples.—*Serpent's Trail.*

◆

"Have you noticed," asked Ham of Shem's wife, "how beautiful Matilda is growing?"

Agnes cast a deprecating glance at the object of the remark, as she stood at the bow watching for the dove. "She doesn't appear a bit better looking than when I first saw her. She's too tall and then she's thin as a rail and her feet are too lar—"

At that moment Shem and Noah joined them and each in turn commented on the growing beauty of Japheth's wife.

A few days later, while Mrs. Japheth was below, helping her husband trim the Polar Bear's corns, Shem's wife and Mrs. Ham found an electric massage vibrator and some sponge electrodes in Mrs. Japheth's bed room.

"There," said Ham's wife, "that explains why she's getting better looking."

"You mean," said Shem's wife, "that is why people have thought she looked better. For my part I can see no improvement in her looks."

"You see," said Ham's wife, paying no heed to Mrs. Shem's comments, but looking at the toilet articles more closely, "she removes wrinkles with the vibrator and imparts vigor to the skin and tones up the system by means of the sponge electrodes."

"Well, all I can say is this:" said Shem's wife with a pout, "If I wasn't presentable naturally, I wouldn't try to make myself so by artificial means," and she looked scornfully at the apparatus.

"I don't believe in such things either," said Ham's wife, and she drew back preparatory to giving the inventions an overhand fling into the sea, when Shem's wife caught her arm.

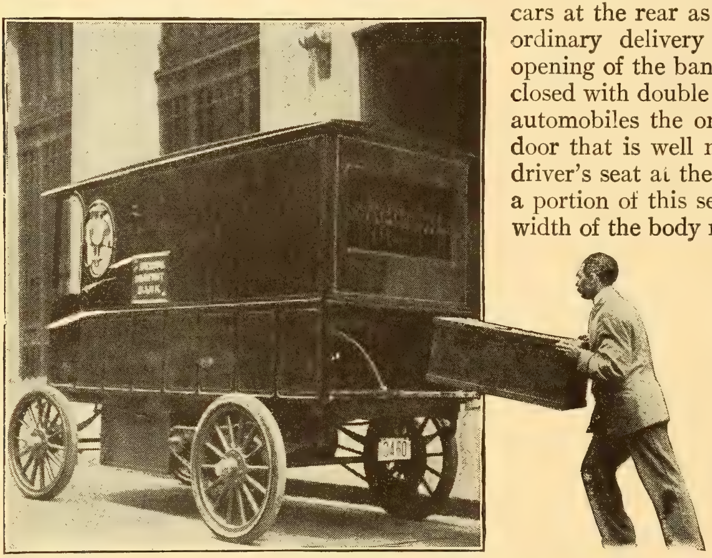
"Let me have the vibrator and one of the electrodes," she said, then lowering her voice to a whisper she added,

"I want to try them and see if it was really that." —*Deluge News*

Transporting Money by Motor

It has been said that the great and permanent future of the automobile lies largely in the field of the commercial vehicle. If this be true it is very safe to predict that the electric motor car will attain a pre-eminence more marked than has characterized it in the sphere of the pleasure vehicle. The commercial car finds new adaptations almost daily and it is notable that in a majority of cases the preference of the hard-headed business men who are responsible for the innovation, is for electrics. The latest outcome of this tendency of the age is found in the recent introduction in several of our large cities of special motor cars devised by leading banks for the transfer of money, gold bullion and securities of all kinds.

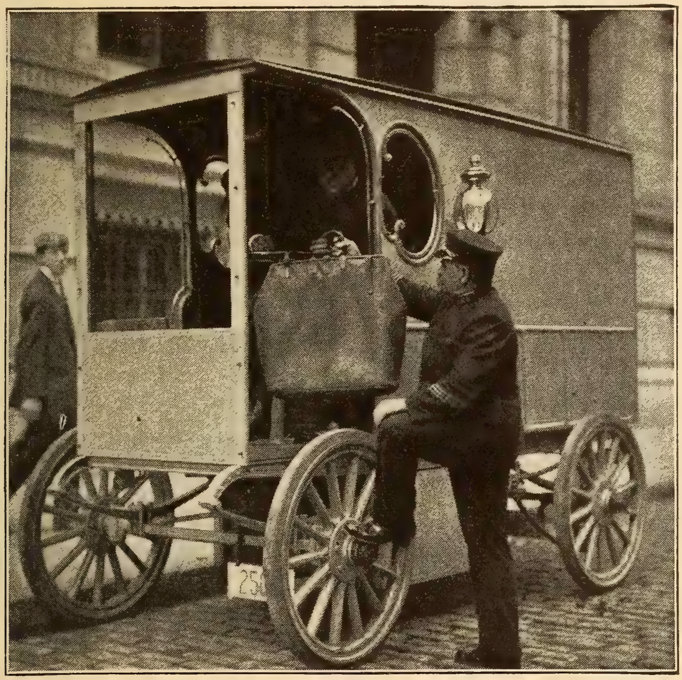
The cars are designed, as may be surmised, for the use of bank messengers and collectors on their daily rounds of visits to other banks and to business houses. Time was when bank representatives made such tours afoot and on street cars, carrying in hand satchels the funds entrusted to their care. However numerous robberies compelled bank officials to put a veto on this plan of freely mingling with the crowd on congested thoroughfares. Then carriages were provided for the bank "runners" but as the business districts of our cities expanded and prominent banks came to have close relations with branches in outlying districts and independent banks in the suburbs and near-by towns the horse-drawn vehicles proved inadequate to "cover" the territory within the narrow limits of banking hours. Necessity proved the mother of invention as in many other instances and bankers in various parts of the country, unconsciously co-operating with their demands and suggestions, have brought about the evolution of the modern bank car.



MODERN ELECTRIC BANKING AUTOMOBILE

The up-to-date bank car presents outwardly, to the casual observer, much the appearance of an ordinary delivery car, but beneath its commonplace exterior it shelters a steel cage or case which makes the vehicle in effect a portable safe. Moreover it is impossible to gain access to some of these cars at the rear as would be the case in any ordinary delivery wagon. If there is an opening of the bank car at the rear it can be closed with double locks and in most of these automobiles the only entrance is via a steel door that is well nigh concealed behind the driver's seat at the front of the car. Indeed a portion of this seat which extends the full width of the body must be raised ere one can enter at the door which is, of course, closed by heavy locks and cannot be opened from the outside except with keys.

However in the new regimé the bankers who must convey millions of dollars of gold, currency and securities through crowded city streets are not depending for its safety wholly upon the steel-lined automobiles, difficult of access as they undoubtedly are. A second line of defense is provided in a corps of armed guards attached to each motor car. There are one, two or three of these guards in addition to the chauffeur. They are uniformed; have credentials as special policemen and are armed with the latest type of magazine or automatic guns. It is customary to have one or two guards ride on the seat with the driver of the car, forming a cordon across the entrance to the repository of valuables, and some banks have adopted the extra precaution of having an armed guard stationed within the locked enclosure during the run through crowded thoroughfares in going from one bank to another.



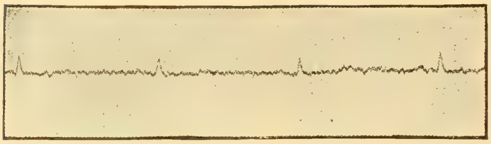
ANOTHER TYPE OF BANK AUTOMOBILE—VALUABLES PLACED IN FRONT

The average bank automobile of the new pattern is fitted with a two to three horsepower motor and is capable of 35 to 45 miles on one charge. It has been found that in actual service a car is very seldom, if ever called upon to cover an aggregate of more than 30 miles in any one day and consequently the use of excessive speed is never required. The charging of batteries is generally done at night in accordance with the usual practice, but the short day that obtains in the banking world affords especial leisure for charging, cleaning, or making any slight repairs. Most of these cars have a carrying capacity of about 1,000 pounds and this is ample for the requirements of a majority of banks, although the heavy, iron-bound chests employed for the transportation of securities, etc., have no slight bulk.

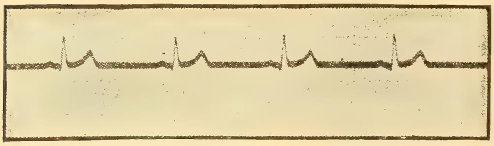
Recording Heart Beats Electrically

When the French physician René Laennec invented the stethoscope some 90 years ago, he laid the foundation for the modern practice of diagnosing which has saved the lives of untold thousands afflicted with diseases of the heart or lungs. In recent years the improvements of Dr. Camman (of New York City) have made this instrument much more sensitive than it was in its original form, so that it admits of finer diagnosing. In some instances a microphone attachment is also said to have been used to advantage, magnifying the sounds so that they could be more clearly noted. But in every case the distinctions had to be noted by ear and any comparisons as to the intensity of the chest sounds or their intervals could only be based on the doctor's memory or his description.

Now in transatlantic telegraphy the siphon recorder (one of Lord Kelvin's masterpieces) traces a permanent record of the fluctuations in a current too feeble to operate a sounder. Why not do the same for the delicate current variations due to impulses of the heart action? The throbbing of the heart makes a difference in the resistance of the circulatory system, so that if a current is passed through the body from one hand to the other, it will vary in strength with the heart beats. Having determined this fact, Professor Bull of Paris (a pupil of the celebrated physiologist Etienne Marey who has experimented so cleverly on the electric phenomena accompanying movements in animals) has been using a similar recording device for tracing heart throbs. The patient is comfortably seated, with each hand dipping into a bowl of salt water so that a battery current passes through him to the instrument which traces the valve action of the heart. Of course the current used must be uninterrupted and too



RECORD OF DISEASED HEART



RECORD OF NORMAL HEART

weak to exert any action on the system. By noting the characteristic curves of those afflicted with different heart troubles, many of the latter can be speedily distinguished so as to avoid any guesswork in the diagnosing. Then repeated heart-beat records of the same patient can easily be compared so as to show just what change has been effected by any given treatment.

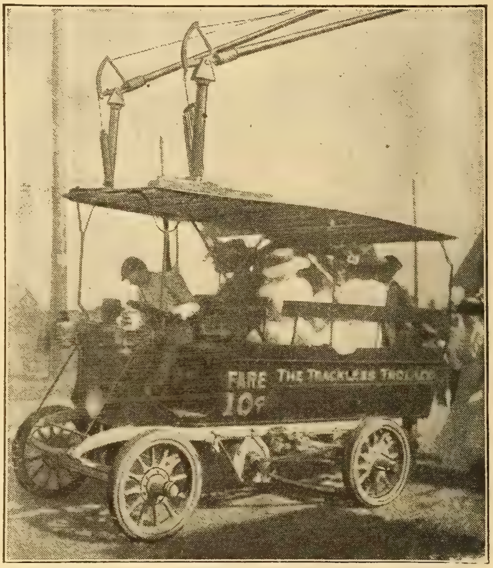
First Trackless Trolley in America

While Germany and other parts of Europe have made extensive use of the trackless trolley system, the first equipment of this kind in America is now in successful operation at Laurel Canyon, Hollywood, California. The service affords communication from the mouth of the Canyon, where the electric railway ends, to Bungalowland, a new settlement further up the Canyon.

Owing to the steep grade and the heavy cost of a regular electric line, a trackless trolley system was tried out. Two overhead wires and two trolley poles serve the car with current which passes into the car over one trolley and out by the other.

The cars attain a speed of from 20 to 25 miles an hour. The Company at present has two passenger cars in operation. Each car accommodates sixteen passengers. It requires eight minutes to make the trip of a mile and a half over a twelve-per-cent grade. On the down trip the power is in use only about half the time.

The cars have a latitude of eleven feet on either side of the road, making it possible for them to turn out for any passing vehicle without losing the trolley. This play is compensated for by a system of springs, shown in the picture, which keeps the trolley wheel in perfect contact with the wire at all times. The cars resemble an automobile except for the two trolley poles mounted on the forward part of the roof of the car. A controller is mounted on the front dashboard while the fuses and cut out switch are overhead instead of underneath, as on a standard electric car.



TRACKLESS TROLLEY CAR IN CALIFORNIA

The roadbed is of crude oil and sand. The cars are making regular trips on a fifteen-minute schedule, the fare for the trip being ten cents.

R. B. YALE.

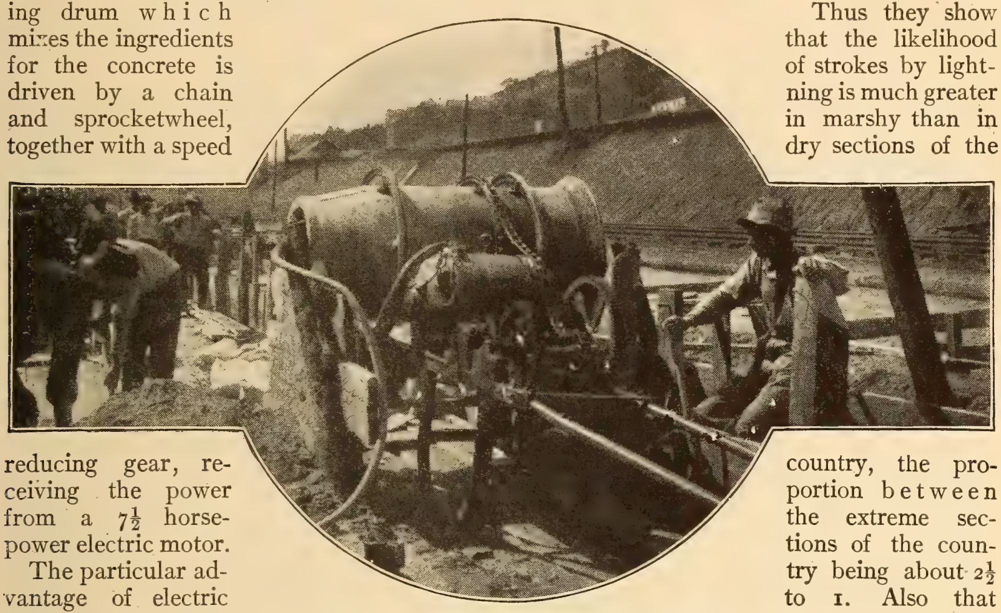
Suspended Railways Conquer Snowstorms

One advantage prophesied for electric railways of the suspended type (as pictured on page 518 of our October issue) is their being unhampered by the drifting snow which might pile up ten or twelve feet high without even reaching the cars. The correctness of this claim was demonstrated last winter by the similarly suspended railway connecting Barmen and Elberfeld, for while it could not maintain its regular schedule during some heavy snowstorms it was the only line in that section of Germany which did not have to suspend its service completely.

Mixing Concrete by Electric Power

Wherever electric power is available it may be utilized to special advantage in the mixing of concrete. The concrete mixer shown in the illustration was used in mixing concrete for the retaining walls at the Edgar Thomson Steel Works at Bessemer, Pa. The revolving drum which mixes the ingredients for the concrete is driven by a chain and sprocketwheel, together with a speed reducing gear, receiving the power from a 7½ horsepower electric motor.

The particular advantage of electric power here lies in the ease with which the whole apparatus may be moved from place to place and in the simplicity of its operation over an engine driven outfit.



CONCRETE MIXER WORKING AT BESSEMER, PA.

Where Lightning Strikes

Although lightning is causing a heavy annual loss of property and some loss of life in nearly all civilized countries (the property loss in the United States alone averaging over a million and a half dollars a year), but little effort has been made towards obtaining reliable statistics as to anything beyond the property loss in insured buildings. The one section of the globe in which more ex tensive figures have been kept for a long enough period to show dependable averages is Schleswig-Holstein, that northermost province of Prussia which Bismarck's scheming wrested from the Danes 45 years ago. In this section, about equal in area to New Jersey but with only two-thirds as large a population, careful records have been kept ever since 1874 as to the havoc played by lightning. A study of these records, as recently undertaken by the provincial Society for Natural History, brings out a number of interesting conclusions, many of which would seem equally logical and likely for the average conditions found in this country.

Thus they show that the likelihood of strokes by lightning is much greater in marshy than in dry sections of the country, the proportion between the extreme sections of the country being about 2½ to 1. Also that the frequency of the strokes decreases with a growth of the forests, but increases with a devastation of the woodlands, a fact particularly well proven there, as no other section of Germany has less woodland than Schleswig-Holstein. The number of strokes per million of buildings averaged 362 per year, being 236 annually for city buildings and 425 for country houses, which makes the rate in the rural districts nearly double that in the cities. Of the houses struck by lightning, the number having wooden or thatched roofs was 2½ times as great as those having slate or metal roofs; but the damage done to the former was about eighteen times as common, since 94.4 per cent of the buildings set on fire by lightning had the wooden or thatched roofs.

In analyzing these records, Dr. Hans Brodersen endeavored to trace some connection between chimneys and the direction of the lightning, but could find no conclusive proof of the popular assumption that chimneys attract lightning, although the chimney was struck in 40 per cent of the cases examined by him. On the other hand he feels convinced that the weather-vanes which have also been popularly supposed to attract lightning, do not act in that capacity.

As to trees, the conclusion drawn from these records is that they do not generally protect neighboring houses and that poplars are by far the most frequently struck. The common notion that oaks are most often devastated by lightning is upset by the figures for a total of 239 trees struck during a period of fifteen years. These comprised 109 poplars (or 46 per cent of the total,) 26 oaks, 23 linden, 21 ash, eleven fruit, ten willow, ten pine, six alder, three elm, one birch and one beech.

During the same fifteen years the loss in life amounted to 30 persons and 393 animals. Of the former 290 were struck indoors, 19 of them fatally; while outdoors the fatality was eleven out of a total of only 22 persons struck. The small number injured out of doors is easily understood, as people naturally seek refuge indoors when a storm approaches and would only be exposed in the open if caught unexpectedly. Then the difference in the percentage of fatalities implies that the force of the lightning is readily spent on the structure itself when it strikes a house or is conducted to the ground by various paths, such as drain pipes, which are better conductors than the bodies of the people in the house. On the other hand, the human body is a better conductor and hence forms an easier path for the lightning from the wet leaves to the ground than is done by the dry trunk of a tree, hence the large proportion of deaths due to exposure under trees in open fields.

A Portable Sub-station

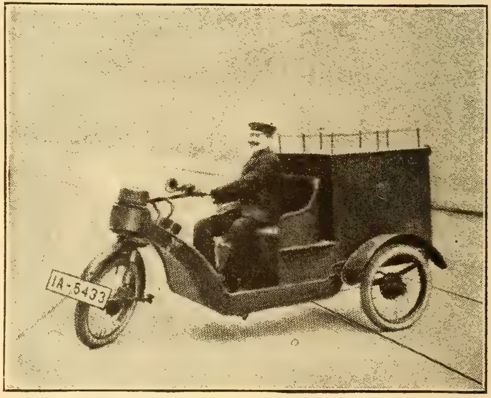
To send a heavy electric current over a long distance requires a heavy wire; and copper costs money. Power companies therefore distribute current over large areas by transmitting it at high voltage but low current to points where needed and then change it to low voltage in what are called "sub-stations," after which it goes out over other wires to customers.

An interesting portable sub-station built by the Westinghouse company is now in operation on the lines of the Fort Wayne and Wabash Valley Traction Company, the whole equipment being contained in an all-steel car 40 feet long. Whenever current is needed in construction work anywhere on the system the car is taken there and connections made to a high voltage line instead of to the trolley wire.

A PORTABLE SUB-STATION

Handling Mail with Electrics

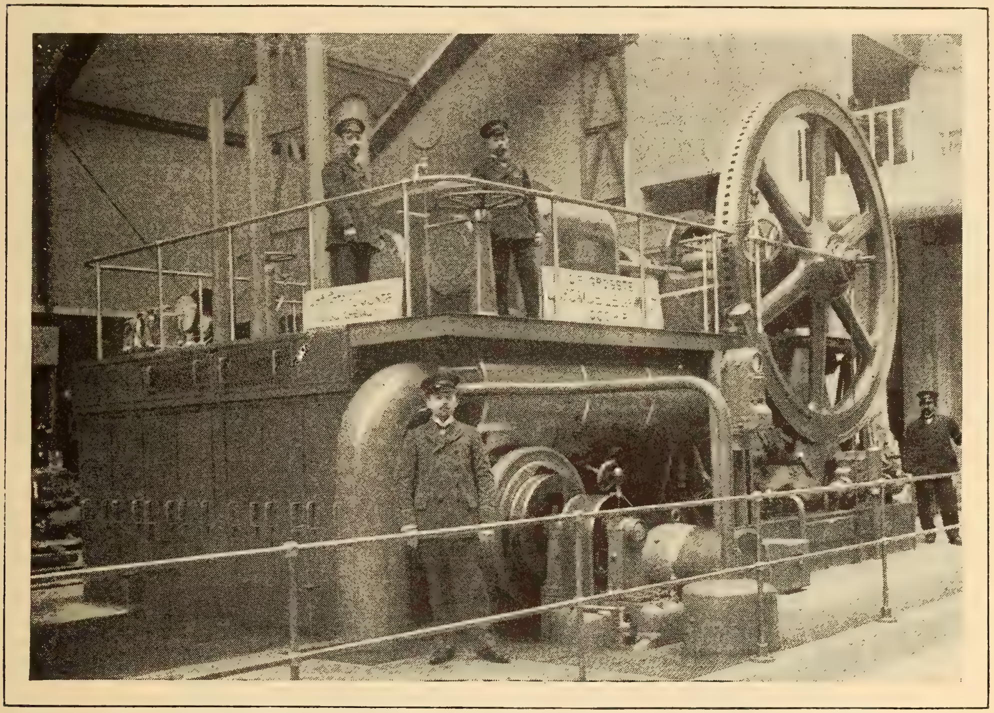
The "familiar step of the postman" may be replaced by the "honk, honk" of the automobile horn. The German Postoffice Department is trying out the electric automobile for carrying the mail, one type of the machine used being a three-wheeled affair. The propelling and steering wheel are one, the motor being mounted just above the wheel. The brake is applied on the rear wheels.



NOVEL MAIL CARRIER'S AUTOMOBILE

Largest Steam-electric "Locomobile"

"Locomobile" is a German term for a particularly compact and efficient type of prime mover, which engineers of that country have perfected. A locomobile is a combined boiler and engine equipment in which the engine is mounted on top of the boiler and drives a dynamo also mounted on the boiler. The one shown in the picture is the largest in the world and is therefore of more than passing interest. The engine and flywheel are plainly seen, but the dynamo is not visible in the illustration, being on the other side of the engine cylinder.


STEAM-ELECTRIC "LOCOMOBILE" AT THE BRUSSELS EXPOSITION

The dynamo of this equipment is capable of developing 735 kilowatts, which is about 1,000 horse-power. The engine is very efficient in the matter of steam consumption, only consuming 9.9 pounds per horse-power. There is also very little heat radiation in getting the steam from the boiler into the cylinders, which is not true where long piping systems are required. The steam is superheated and delivered to the cylinders at a pressure of ten atmospheres.

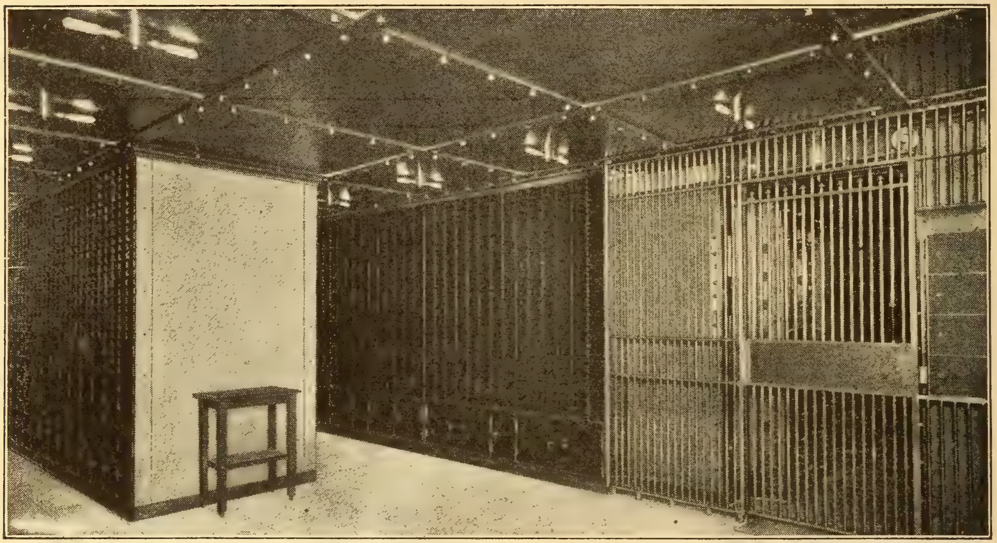
This particular equipment was installed at the exposition at Brussels, Belgium, and supplied current for lighting and power service operating continuously day and night.

Frictional Electricity on the Violin

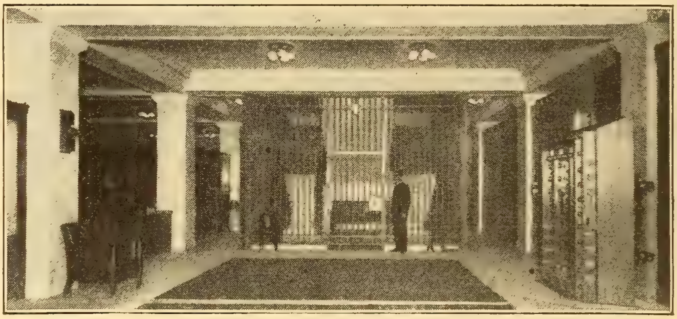
In cold and snappy weather when we generate enough frictional electricity in walking over our carpets and rugs to get a shock when we touch radiators or metal fixtures, what becomes of the same when generated by the playing of a violin? According to the volume of transactions published by the Royal Philosophical Society at London for the year 1777, William Henley proved 133 years ago that the strings of both the bow and the violin become oppositely electrified during the playing. If they do—as our musical readers can easily verify—they must attract each other. Now who can tell just what effect this has on the playing? Does it make the bow press more firmly on the string towards the end of each stroke? Does it make the bow snap against the string with a jerk when again approached to it and does it add to the effort of raising the bow from the strings? In other words, must the violinist reckon with these frictional electrical effects in dry, cold weather?

Electrical Protection of Vaults

The upper illustration on this page shows a modern banking vault as just completed for the old Colony Trust Company of Boston. In this vault electricity has been put to every possible use including the lighting of the great steel chamber with a peculiar type of long tubular incandescent lamps which show up plainly as the source of light with which the photograph inside the vault was made.

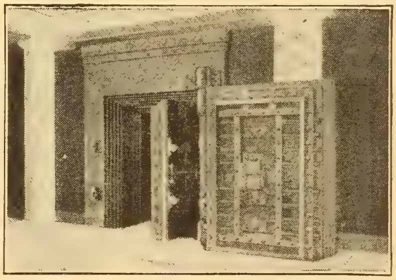


BANK VAULTS WHICH ARE PROTECTED BY A CHARGED WIRE MESHWORK



ELECTRICALLY OPERATED ELEVATOR FOR CONVEYING CURRENCY AND SECURITIES FROM BANK TO VAULT

The vault door giving access to the vault is made of armor plate between the three layers of which is electric wire netting so arranged that the slightest hole drilled through any part of the door will short circuit one or more of the fine wires and instantly call the watchman. The interior of this vault is protected by a steel armor plate ceiling and floor, on the outside of which are several layers of charged wire netting which serve the same purpose as that in the vault door.



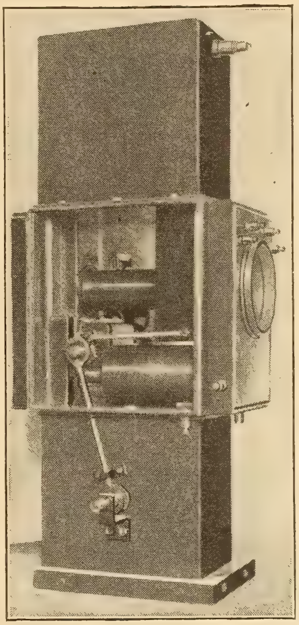
ENTRANCE TO THE VAULTS

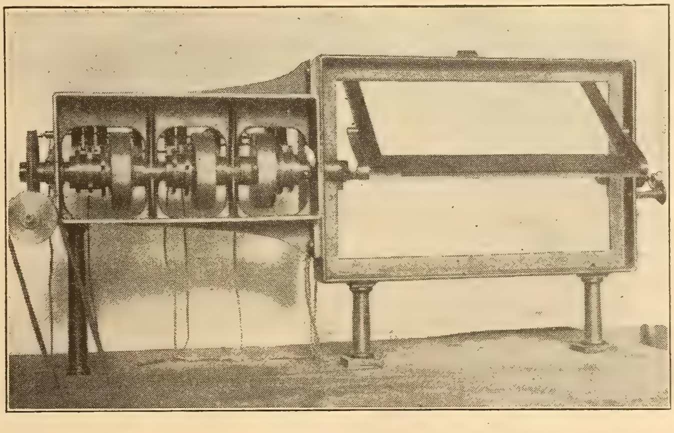
To guard against dishonesty on the part of deposit box holders an annunciator in the office of the cashier of the bank indicates which box is being opened by a box holder, and the man in the office may immediately learn whether an attempt is being made to open a box that is not rented by the party attempting to gain access thereto.

As a further protection against the negligence of any of the employees a tiny electric light near the teller's desk keeps him constantly informed as to whether the vault is locked or unlocked.

Recording Checks with an Electric Camera

A camera in which the shutter opens and closes automatically when the object is ready for exposure, is certainly a rarity, and still more so if it will make a thousand such exposures in an hour. Such a device is the check photographing camera invented and developed by Thomas Jansen, assistant cashier of the National Bank of the Republic in Chicago. It was designed to replace the slow and laborious method of keeping a written record of each check deposited with the bank and of the various endorsements on the same, whereby the check can be traced and replaced if lost. As these records are only a safeguard for the bank and are not often consulted, a miniature negative showing both sides of each check was deemed ample, provided that the negatives are sharp enough to be easily read with a convenient magnifying glass. A film with 6,000 of these negatives easily slips into a case 1½ inches high and 4½ inches in diameter. Developing and fixing the film takes about twelve minutes, hence in the four hours, time available daily in banking practice one man alone can photographically record the face of over 4,000 checks, or both the face and back of over 2,000 checks. The camera is also provided with safety devices to make sure that the film always feeds before the shutter opens, that the shutter opens and closes promptly, and that there is still film on the spool.


ELECTRIC CAMERA WHICH TAKES 1000 PICTURES PER HOUR


COPY HOLDER USED WITH CHECK RECORDING CAMERA

These important precautions complicated the apparatus somewhat, but were all successfully worked out by Capt. A. de Khotinsky (later mechanician of Chicago University), who built the practical camera to meet these exacting requirements.

The moving parts in the camera proper are all actuated by magnets which are so arranged that if the film fails to feed or if the shutter fails to operate, the whole mechanism stops. The lighting is done by a focusing arc lamp which is self-adjusting, while an alarm bell tells the operator when the film is nearly exhausted.

The Jansen apparatus consists of a check exposer driven by an electric motor and connected electrically to the camera which is mounted at the other end of a table, four or five feet off, with the lamp alongside it but screened from the operator. All the latter does is to drop the check into the pocket between a vertical and an inclined glass plate and to push a button which starts the moving cams and contacts on the shaft of the check exposer. Then the glass pocket closes so as to hold the face of the check vertical while the film feeds about ⅝ of an inch. Next a shutter opens and closes automatically and the film feeds again while the check holder rotates so as to expose the back of the check. Then the shutter acts again and the glass pocket opens so that the check can be replaced by another.

After exposing the day's run of checks, the film is cut off, strung on a special spiral frame, developed in a tank and wound on a compact spool for filing. Before exposure, each check is stamped with a consecutive number to identify it and the bank's entries or references (as in sending it out for collection) merely mention this identification number. Should it be necessary to refer to it, the spool is slipped into a box containing an empty reel and an opalescent glass plate with an incandescent lamp under it the cover of the box having a strong magnifying glass. Then the film is fed rapidly over the glass plate to the reel until it shows the check having the desired number, which check can easily be read right from the negative through the magnifying glass as the light of the lamp brings out the lines sharply.

Who Discovered Magnetism?

Of the three common explanations as to the origin of the word magnet, the most prosaic tells us that it is derived from the Latin word magnis (meaning heavy) and refers to the high specific gravity of the magnetic iron ore known as lodestone. Another theory attributes the name to Magnesia —not the section of Greece known by this name, but the city in Asia Minor founded by emigrants from this section. It is there in Asia Minor that the lodestone (a form of the ore which is found in this country as magnetite) was first said to have been found by a Greek some three thousand years ago. Hence the lines of the Roman poet Lucretius, whose poems are so often in accord with modern science:

"Now, chief of all, the magnet's power I sing
And from what laws the attractive functions spring:
The magnet's name observing Grecians drew
From the magnetic region where it grew."

But still more poetic is the explanation which traces the word magnet back to a shepherd named Magnes who is said to have made this discovery of the lodestone on Mount Ida in Asia Minor. One version of the legend claims that his shepherd's crook, which had a rod of iron, was held by the lodestone in the ground so that he could not carry it away. The other legend goes still further by claiming that he stepped on the magnetic ore unconsciously and that this held him a prisoner owing to the iron nails in his shoes. Either legend would have lent itself to an interesting picture or work of sculpture and it would not be surprising if one of the numerous exploring parties in the old Greece should unearth some representation of the amazed shepherd.

Testing a High Voltage Line

A portion of the high voltage power transmission line by which Ontario is to be supplied with current from Niagara Falls was recently tested out. A pressure of 165,000 volts was turned upon the wires and no sparking whatever was noticeable, although this is 55,000 volts higher than the voltage to be used on the line. The test satisfied the hydro-electric Commission that their plan for the distribution of power is a success.

Patents on the Electric Flasher

In the October number of Popular Electricity a description was given on page 531 of an electric flasher. It develops that basic and detail patents on flashers of this type are held by a company prominent in the manufacture of electric heating devices. We were unaware of this at the time the article was printed, and it is of course not the policy of this magazine to encourage in any manner the infringement of patented devices. It is not out of place here to say that any one making the device would be liable to infringement proceedings.

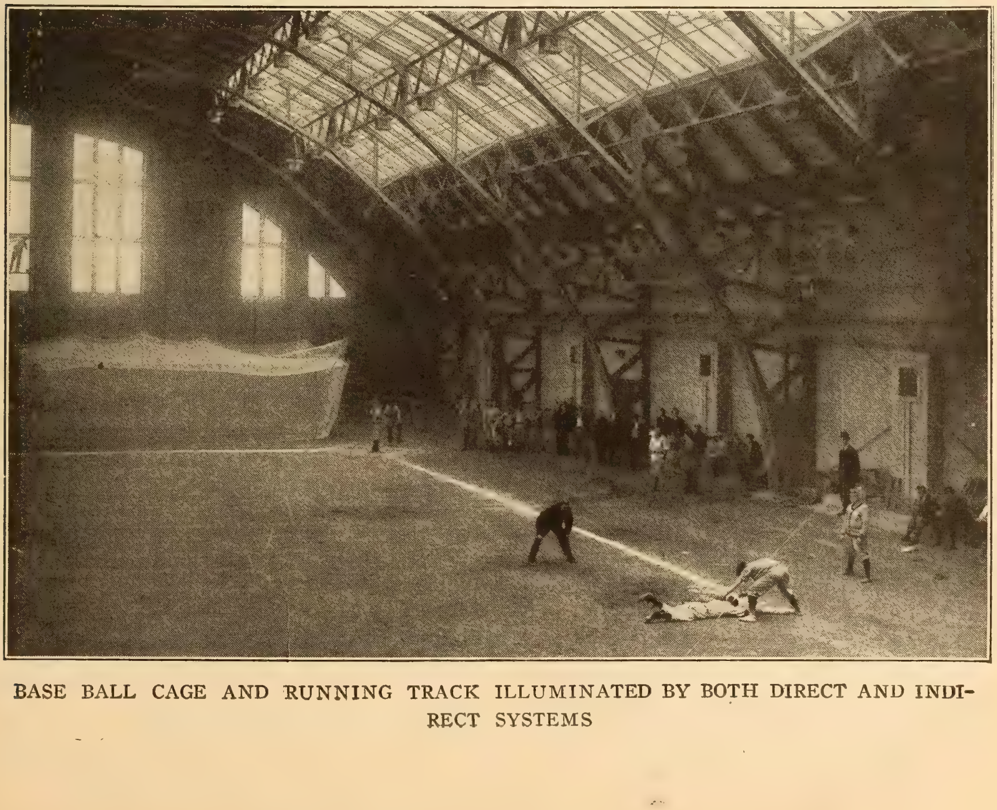
Locating Springs Telephonically

According to reports from Paris a local engineer named Dienert has been successfully using a sensitive microphone with a listening tube for magnifying the rumbling or dropping of underground streams of water so as to make them audible to the human ear. It is claimed that several subterranean springs were thus located at depths of about 50 feet and if further tests substantiate these reports, we may at last have found what believers in the so-called divining rods had been seeking for centuries.

EXTERIOR OF NORTHWESTERN UNIVERSITY GYMNASIUM

Lighting a Big Gymnasium

Northwestern University, Evanston, Illinois, has just completed, at a cost of approximately $200,000, a new gymnasium which is of interest on account of its size and also because of the question which arose as to how the track room should be lighted. This room is 193 by 129 feet, affording a straight-away sprinting course of 60 yards. The highest point of the arched roof is 50 feet above the floor. To light the track and floor, and at the same time illuminate the walls and ceiling so that in games of basket ball and indoor baseball the ball can be easily followed, the direct and indirect systems of lighting are combined. Attached to the steel-arch trusses are 156 box shaped



BASE BALL CAGE AND RUNNING TRACK ILLUMINATED BY BOTH DIRECT AND INDIRECT SYSTEMS metal and art glass lantern fixtures as shown in the picture. Each fixture contains a 100-watt tungsten lamp suspended by a short flexible cord within a deep corrugated mirror-glass reflector which throws the light downward. For the indirect lighting two mirrored half-reflectors pointed toward the ceiling are placed on the top of each lantern fixture and one sixteen candlepower carbon lamp used in each until less fragile 25-watt tungsten lamps are produced, the breakage on these being too high at present. All the wiring of the building is in metal conduit. At the side walls of the building may be seen the metal cut-out cabinets built into the trusses and containing push button switches controlling the lighting circuits.

The push button portion of these switches is connected through a solid brass plate on which each switch is marked with the circuit it controls.

Opal reflectors are used in other parts of the building except the trophy and social room, where box art glass fixtures add to the attractiveness. Pillars at the front of the building are also enclosed in long rectangular art glass box fixtures for use in lighting the roadway and entrance on gala occasions.

Electric Power Cleans Streets

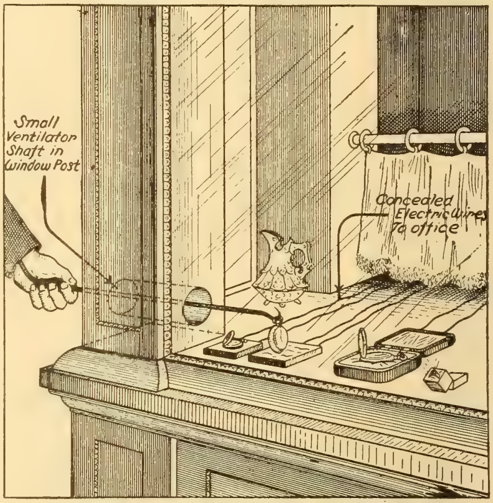
A prophecy that the children of the near future generations may have to go to the museums to find out what the word "horse" means seems premature, yet almost daily in the large cities instances may be found where horse energy is being displaced by electrical energy.

ELECTRIC STREET CLEANING CART

Berlin, as explained by *Die Mitteilungen der Berliner Elektricitætswerke,* affords an example of the change by the use of an electrically driven street washing machine here illustrated which is furnished power by a storage battery of 40 cells. Results have been most satisfactory and the fact that the care of the horses is eliminated has done much to increase its popularity.

How a Thief Was Caught

A thief was recently trapped in Montreal by the aid of an ingenious application of electricity. Watches and jewelry had mysteriously disappeared from a show window and for a long time no one could account for the loss. Finally some one remembered that in the lower wood work enclosing the window some holes had been made for ventilators, and when another watch had disappeared and its case was found to be drawn over slightly toward one of the holes it was plain that the thief had removed the watch through the hole by means of a wire. So an electrical trap was set to catch him in the act.


Small Ventilator Shaft in Window Post
Concealed Electric Wires To office

HOW A THIEF WAS CAUGHT

Several watches were disposed about the window with concealed wires connecting them in what is known as a "closed circuit" alarm. As long as the circuit in such an alarm is not opened no signal is given, but when it is broken at any point a bell begins to ring.

It was not many days before the "curtain call" on the act was announced to the men in the store. It was then that the man with the hook "got the hook."

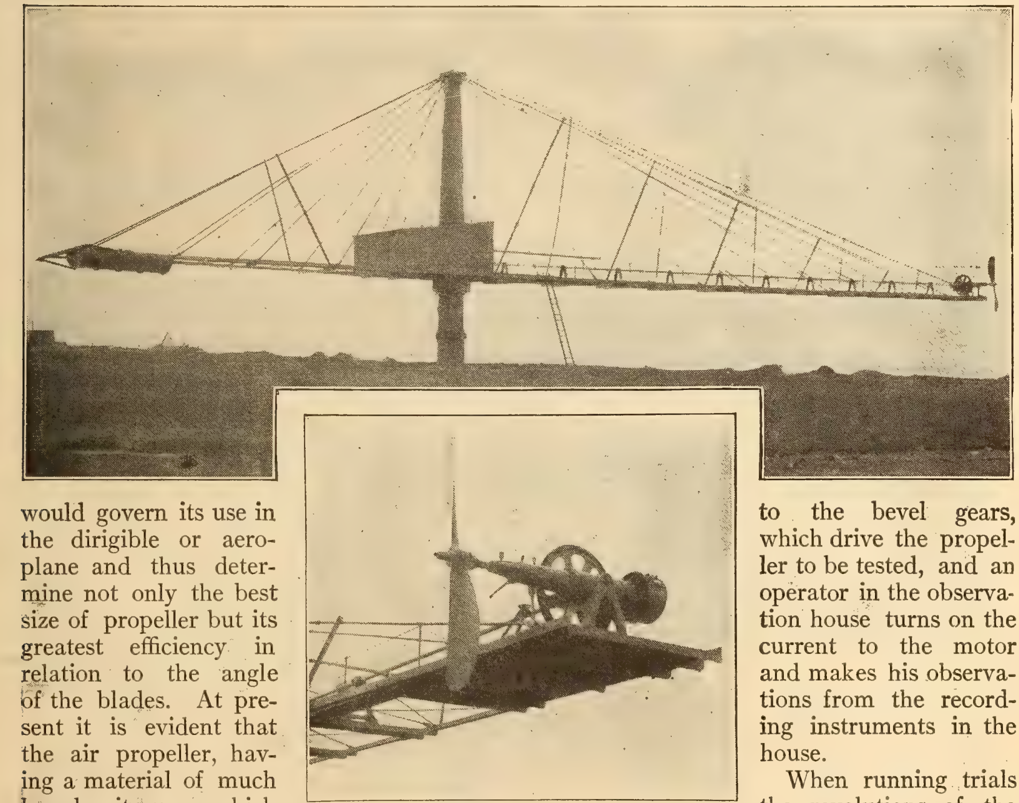
Testing Airship Propellers

Perhaps no move of recent times is more indicative of the ultimate success of the airship as a practical business commodity than the action that an English firm of naval shipbuilders has taken in erecting at Barrow-in-Furness an electric air propeller testing plant.

At present the system usually used in the securing of angles for propeller blades is to take the same angle that is used in power fans and make it up in laminated wood. No firm has thought it possible to make tests of a propeller under the same conditions that would govern its use in the dirigible or aeroplane and thus determine not only the best size of propeller but its greatest efficiency in relation to the angle of the blades. At present it is evident that the air propeller, having a material of much less density upon which to work, will require greatly different lines from those of the water propeller; furthermore, the greater speed at which it must be run to secure an equal thrust on the air introduces complications in construction to withstand the centrifugal force and back pressure which are certain to be developed.

With the idea of testing air propellers under the same conditions that exist when in actual use the English shipbuilding firm has erected at a cost of about $100,000 a huge steel cantilever, which rises 70 feet from the ground and is accurately balanced in such a manner that the entire structure is free to revolve from the head of a great cast iron column. At a distance of 110 feet from the balancing point on the end of one of the arms is affixed the propeller to be tested. A shaft runs from an observation house in the center, containing a 100-horse power electric motor, to the bevel gears, which drive the propeller to be tested, and an operator in the observation house turns on the current to the motor and makes his observations from the recording instruments in the house.

When running trials the revolutions of the propeller may be varied from 250 revolutions per minute to over 1,000 and propellers absorbing as high as 200 horse power may be tested. The passage of the propeller through the air may be regulated by the use of resistance screens and the highest speed attainable is 70 miles an hour. The whole



SWINGING CANTILEVER FOR TESTING PROPELLERS cantilever is balanced by letting water in or out of the ballast tank on the other extreme of the structure and the whole rests on ball bearings concealed in the lower section of the iron column.

Conditions for this machine are exactly similar to those of a ship running in a straight line through the air, as an ingenious method of compensating for the circular path of the propeller has been arrived at without which the portion of the propeller blade nearest the center would travel less rapidly than the outer portion. A means of accurately measuring the thrust of the propeller to within one per cent of 500 pounds is included in the design of the bracket and gearing, the propeller shaft being allowed to move forward against a spring, which movement is mechanically recorded in the observation house.

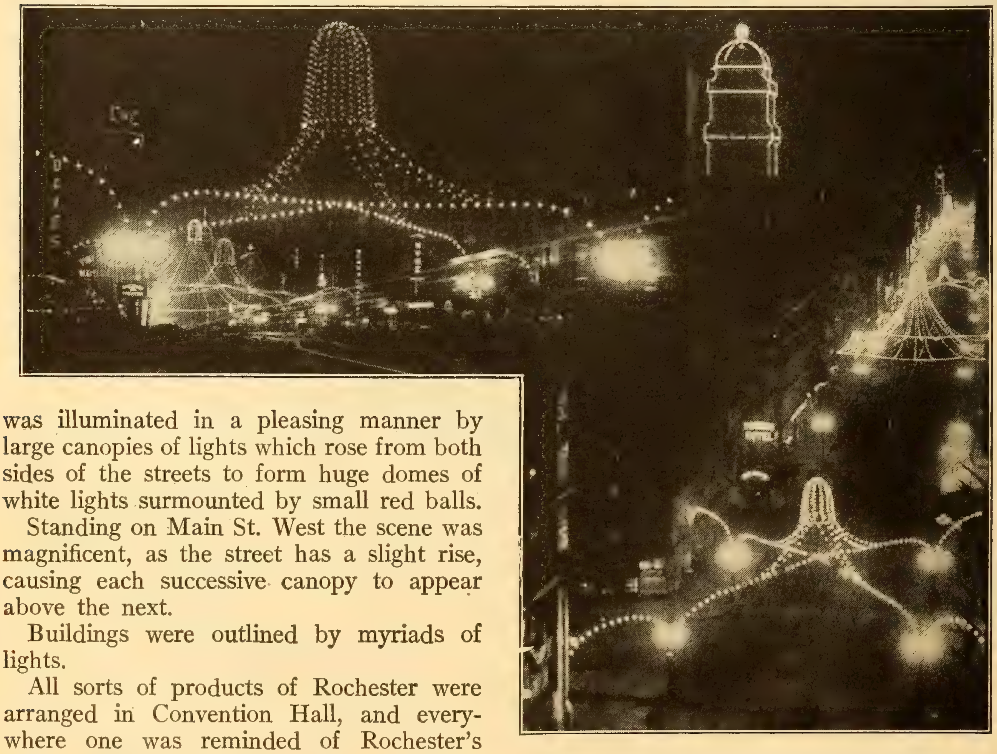
Rochester's Industrial Exposition

During Rochester's Industrial Exposition which was held in October, the main street was illuminated in a pleasing manner by large canopies of lights which rose from both sides of the streets to form huge domes of white lights surmounted by small red balls.

Standing on Main St. West the scene was magnificent, as the street has a slight rise, causing each successive canopy to appear above the next.

Buildings were outlined by myriads of lights.

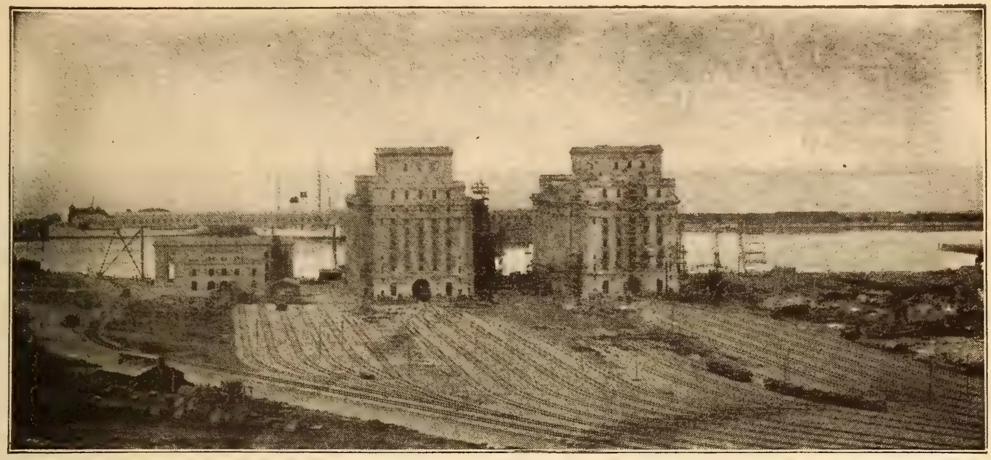
All sorts of products of Rochester were arranged in Convention Hall, and everywhere one was reminded of Rochester's slogans, "Rochester-made means quality," and "Do it for Rochester."



ILLUMINATIONS AT THE ROCHESTER INDUSTRIAL EXPOSITION

Platinum in Lamps

Before Edison produced a practical carbon filament and thus made the incandescent lamp a commercial article, many experimental lamps had been built with the filament made of a single loop of platinum sealed into the bulb so that its two ends projected and made the terminals of the lamp. As platinum is fully as costly as gold, its price alone would have made its use prohibitive. With the coming of carbon as a practical filament material, the use of platinum was restricted to the short lengths needed for passing through the glass of the bulb. Even this length has gradually been reduced, but so tremendous is the annual consumption of incandescent lamps that the cost of the platinum used for this purpose is estimated at half a million dollars. Efforts to replace the platinum with inexpensive metals or alloys have not been very successful as yet, but in view of the large saving that might be effected, a good deal of experimenting is being done along this line.



LARGEST GRANARIES OF EUROPE—CONSTANTZA HARBOR

Europe's Greatest Inland Harbor

In the September, 1910, issue of POPULAR ELECTRICITY there was contained a brief description of the extensive harbor improvements in the Roumanian city Constantza. Some photographs of this unusually interesting work have since become available and are here reproduced.

After completing in 1894 the regulation of the Sulina arm of the Danube which ensures a safe entrance into the river, and inaugurating in 1895 the huge railway bridge at Cernavoda, constituting the shortest connection of the Black Sea with the Baltic and North Sea, and in 1896 the Iron Gate canal, which likewise is of much importance for commercial connections, the Roumanian Government in October, 1896, commenced the extension work of Constantza Harbor, which has recently been opened to navigation.

In order adequately to gauge the importance of this harbor it should be remembered that the rather limited coast of Roumania does not comprise any natural harbors worth speaking of. The Government, intent upon furthering the trade and commerce of the country, therefore decided on creating an artificial harbor basin in connection with the existing, though quite unimportant equipments of the town of Constantza situated on the coast of the Black Sea.

The harbor mainly serves for the shipment of the greater part of Roumanian export articles. This installation, comprising granaries for millions of tons of corn, is the largest on the Continent.

The harbor is protected against the tempests of the Black Sea by extensive piers comprising a number of quays, large mechanical and locomotive workshops, docks, granaries and loading plants.

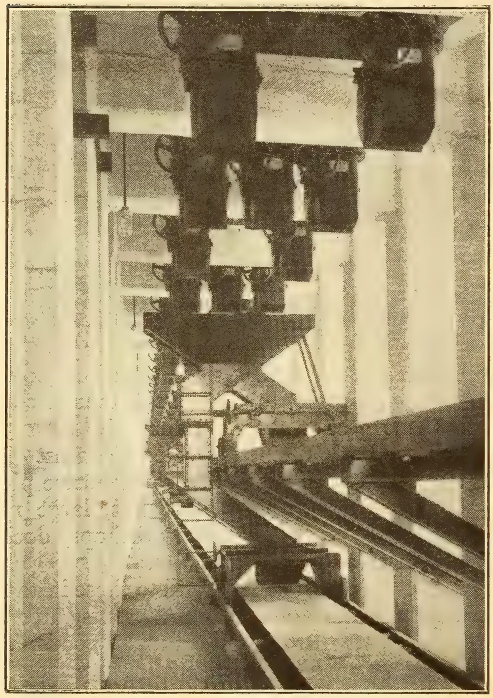
Special attention was paid to those installations which are intended for ensuring an easy and rapid unloading of export goods, the most important of which are corn, petroleum and timber.

The equipment provided for the transfer of corn comprises two huge granaries built of concrete, each of which contains 255 silos of a total capacity of 70,000 tons, plant for the immediate transfer of corn from railway cars into vessels, an iron frame 1,870 feet in length with hoppers for unloading the corn, supplied by belt conveyors, into telescoping tubes, and thence into vessels, and quays of the same length for the anchoring of five (and if desired even ten) vessels to be loaded simultaneously.

All the operations in handling the corn are effected by horizontal belt conveyors and vertical elevators. In addition to storing the corn, and transferring it into vessels, the cleaning, aerating and mixing is effected in the granaries.

Outside of corn, petroleum and its products are of special importance for export from Constantza harbor. The installations provided for the storing and shipping of petroleum are situated in the western part of the harbor and comprise a plant for receiving and unloading the petroleum trains, installations for storing the petroleum products, and machinery for transferring them into vessels.

The petroleum trains arrive at a special station comprising six feeding tracks connected up with the various railway lines terminating at Constantza. Between these six tracks are provided four discharging conduits to which are connected flexible tubes communicating with the discharging cocks of the petroleum wagons. Each of these four lines of conduits is destined for some special product (benzine, refined petroleum, distilled petroleum and residues) and is able to unload a whole train containing the same product, conveying it under the influence of gravity into a storage tank from which it may be pumped into the tanks on the ships.



CONVEYOR BELT BELOW THE GRAIN BINS

These extensive harbor works, arranged on quite modern lines, are mainly operated by electricity, which also provides the lighting.

The electrical energy is generated in a large power house, situated close to the harbor basin on an artificial plateau made from concrete. This comprises at the present moment four generating sets of a total capacity of about 1,500 horsepower.

The greater part of the electrical energy is used up in the huge granaries, all the conveying belts and elevators, as well as the cleaning and sorting machines being operated by motors. An electrical signaling system serves to superintend and check the weighing operations.

The belt conveyors and traveling elevators with telescoping tubes installed on the extensive iron frames alongside the corn quays for transferring the corn into vessels are likewise operated by electricity. The railway trains supplying the corn are taken by electrical locomotives from the termini to the granaries, or as far as the corn vessels.

The petroleum ships which before entering the petroleum harbor (separated from the remaining harbor basin) have to put out their fires, are drawn into the petroleum basin by a number of electrically operated capstans which are a very convenient form of power. A lift with electrically operated capstans serves for the repairing of small-sized ships.

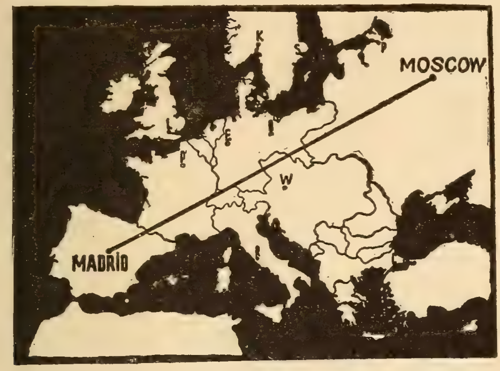
These harbor works, in the construction of which the most recent achievements of modern engineering have been utilized, will soon make the harbor of Constantza one of the centres of commerce on the Black Sea.

Dodging German Taxes

The varied special taxes which Germany is levying in order to maintain its tremendous military and naval expenditures are having curious effects, as the natural tendency of the public is to avoid the use of the articles thus taxed. For instance the tax on matches has given such an impetus to the manufacture of lighters using either an electric spark or one allied to the old flint-steel method that over a hundred types of such lighters are already on the market. Now the tax on arc lamp carbons (amounting to about 10 cents per pound of the carbons) is likewise being felt and the users of the old time "open arc" lamps are replacing these with long-burning types which consume only about 1-15 as great a weight of carbon per hour, thus cutting the government's expected revenue down to a mere nominal amount.

Across Europe on Welded Rails

The smoother riding due to the welding of rail ends to each other means added comfort for the traveler and less wear on the rolling stock. Both reasons have contributed to the extensive use of electric welders for this purpose not only here, but in Europe as well. Indeed, a recent estimate of the trackage thus smoothly joined made it reach from Madrid to Moscow—a particularly fine showing when we consider that governmental railways with their lack of competition are often inclined to stifle progress.



ACROSS EUROPE ON WELDED RAILS

Increasing Life of Tungsten

The hot wire system for tungsten lamps is being used on eastern railroads to minimize breakage. A small current, keeping the filament at a dull red, is always on the line, thus giving longer life to the filament. The lamps are lighted from storage batteries at 60 volts, this being reduced to four volts when the lamps are extinguished.

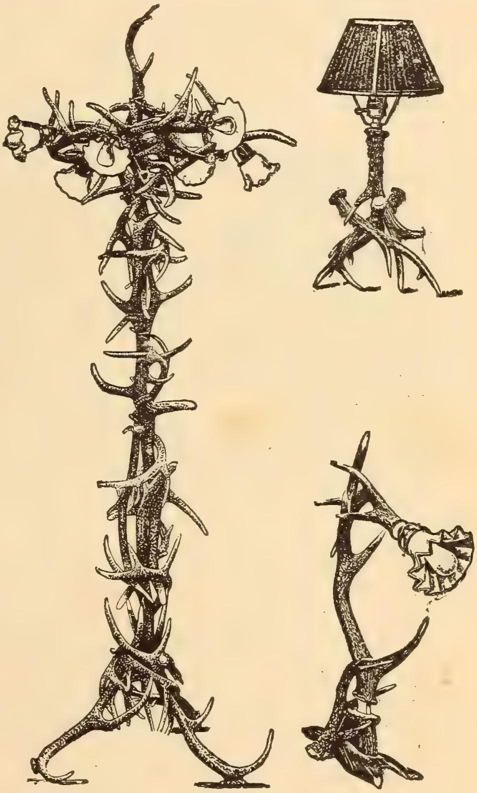
Hoosac Tunnel to Be Electrified

A contract involving more than $1,000,000 has been awarded to the Westinghouse Electric and Manufacturing Co. for apparatus to be used by the New York, New Haven and Hartford Railroad which will electrify the famous Hoosac tunnel under the Hoosac mountain in Massachusetts.

This tunnel was completed in 1874, after years of construction work. It is four and three-quarters miles long, exclusive of approaches. The total length of the electrification work is seven miles, and it will eliminate for good the long-standing trouble of smoke and foul gases in this tunnel while trains are passing through. The general plans for the electrification are uniform with the work on the main line of the road, and are conducted with the one idea of ultimately making the New York, New Haven and Hartford an electric line.

Antlered Electric Fixtures

To the enthusiastic sportsman the sight of antlers or other trophies of the hunt is always a source of pleasure as it recalls so many enjoyable days and events. The conventional lighting fixtures with their polished brass or oxidized copper tubes and balls may be more true to the canons of art, but the lover of outdoor sport gets only a tame sort of satisfaction from them. To him the rustic intertwining of horns and antlers makes by far the stronger appeal. One German firm is catering to this taste by offering a whole line of antlered fixtures to please the huntsmen.



Learning to Use our Forest Products

By DENTON L. GEYER

Editorial Note.—We have in mind a certain large river in the state of Wisconsin. It measures in width a quarter of a mile to a mile from bank to bank. Twenty years ago, before the great forests to the north had been hacked to pieces, it was a noble stream. Today it is a maze of sand bars and islands and, except during spring freshets, one may wade across it by judiciously picking his way. Denuding of the forest lands has wrought the change, in this and in thousands of other cases. When we speak of the conservation of natural resources we mean for one thing the great movement now on to remedy such conditions and conserve not only our forests but the water supply of our rivers; for another thing we mean the development of the water power of these same streams, to be turned into electrical energy. These two features of the conservation movement are closely interlinked. The following article, therefore, treating as it does of steps now being taken to prevent waste of our forest products, has a direct bearing on electrical development and merits attention of the readers of an electrical magazine.

Realizing that one of the most important phases of the great conservation movement in the near future will be to save every scrap of wood taken from our forests, the United States has established one large laboratory to determine methods for using all the lumbering products to the greatest possible advantage. To save our forests it is necessary, we know now, to utilize a larger fraction of the tree that is cut than has been done in the past, and to keep the used fraction in service for a longer period than has been done in the past. It is primarily the purpose of the new laboratory to work out processes by which the waste parts of a harvested tree can be given a market value.

In Twentieth Century industry, conservation means concentration—centralization of machines, of brains, of efforts. Recognizing this tendency as sound economics, the United States has concentrated in this one immense laboratory its entire equipment and its entire experimental staff, that the tests to be undertaken may be carried out on a large scale. Heretofore such work as has been done has been scattered through the country in some half-dozen necessarily incomplete plants; these have now been dismantled, and their equipments combined.

Of the possible locations for the new project, Madison, Wisconsin, was chosen because of its central situation in the nation as a whole, and because here a building and site would be provided without any cost to the Forestry Service whatever. A $44,000 structure has been erected and presented to the federal government by the University of Wisconsin. Even before its formal dedication in June, the actual routine of work had begun. The building occupies a place on the campus of the University, and in return for its use the forestry experts detailed to it will give as a regular part of their duties a course of lectures to students of the university interested in forestry.

Situated not a great distance from the northern forests, the laboratory has all the materials for experimentation at hand. Throughout the past year government forest rangers have been scouring the nation's woods for the specimens that would be needed in these experiments. As a result, the yards and sheds of the new building are piled high with barks and bits of trees unknown to curious northwestern lumbermen. There are strangely grained logs of the most pungent odors, there are bundles of "saplings" hardly bigger than fishing poles, there are little cross-sections of trees coming all the way from regions semi-tropical. And all are neatly lettered and numbered.

But why this carefully arranged collection? There is a scope of work here that is worthy of nothing less than a national enterprise, for the area of forest growth represented by these specimens is as great as the nation itself. The staff of experimenters holds some of the most able men in any department of the government's employ. Of what import is this growing interest in forestry study?

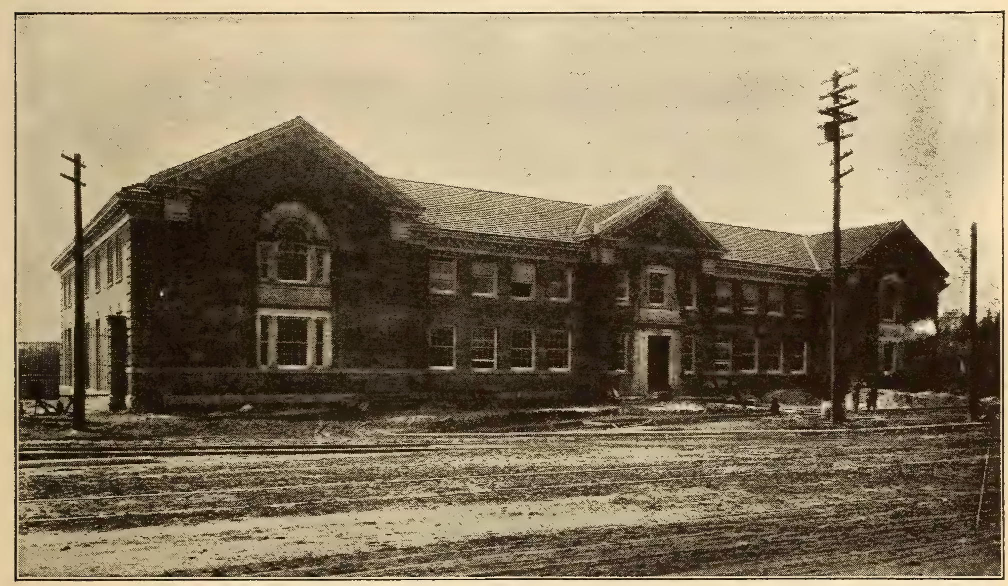
Today we are cutting our forests, says ex-Chief Forester Pinchot, just about three times as fast as they are reproduced. Not that such an amount of wood is needed;

there is enormous waste in every operation,—in cutting, logging, sawing, and every later stage of wood manufacture.

The paper industry offers one way of saving this waste. The wood that is lost in the form of slabs, edgings, cull logs, and unused tops and butts would supply our pulp mills five times over. But can it be used? At present the only kind of wood available for paper is the spruce; and it is a question whether other kinds can be made to serve. To solve this problem is one of the major *raisons d'être* of the new laboratory. Every kind of wood in any way resembling spruce will be thoroughly tested out under every kind of condition. For this purpose a miniature pulp mill has been set up, with machinery comprising a grinder, a beating machine, a "digester" each for the soda and sulphite processes, and a Froudrinier completing machine turning out a continuous fifteen-inch sheet of finished paper. Since all timber for paper must be ground to pulp before using, irrespective of size, it is obvious that a collection of chips will serve about as well as an entire log.

Today the country is using four million tons of paper annually. And since the available supply of spruce is rapidly disappearing, the subject of cheaper paper making—lowering the "tax on intelligence"—is a subject pretty well worth investigation.

The South, too, is now being rapidly devastated of its forests. If the spruce is useful to the North, the pine is the one supremely useful tree of the South. And as the spruce is being sacrificed for paper, the pine is being sacrificed for tar and "naval stores." The pine's destruction is largely the result of the wantonly wasteful methods by which these commodities—turpentine, rosin, and the like—are procured. The "production process" is barbarously simple: in the selected tree a notch or "box" is cut, so deep that the exuded tar may be caught in the wound. And by this "boxing" the tree is either killed after a time, or so weakened that the next hard wind storm blows it down.

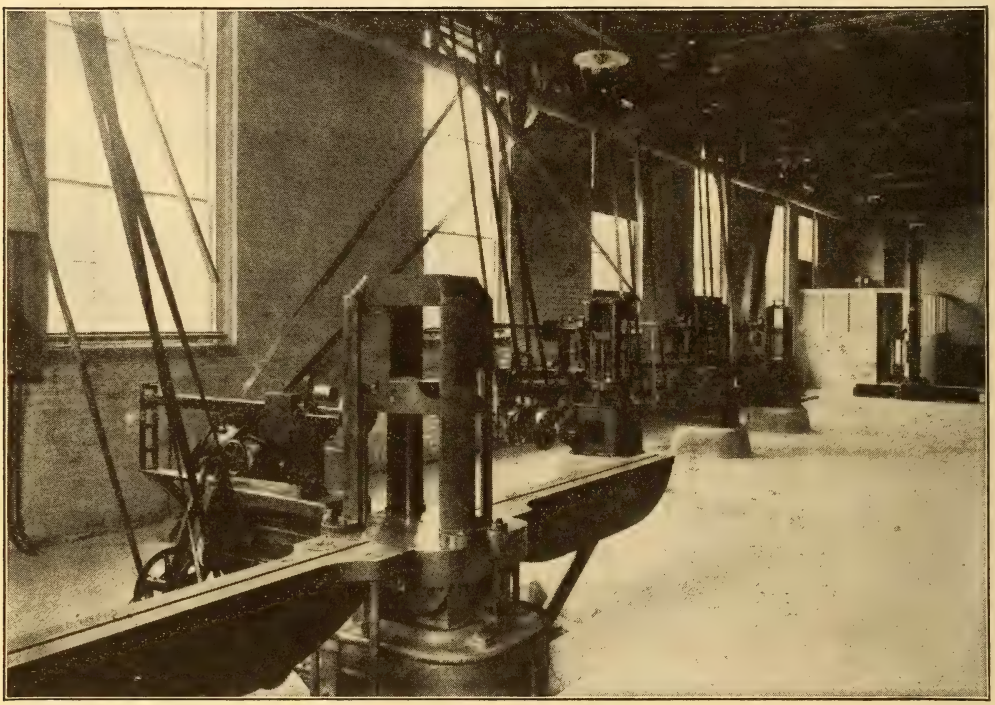


NEW UNITED STATES FOREST PRODUCTS BUILDING AT THE UNIVERSITY OF WISCONSIN

The remedy is to devise a process by which these resinous products can be chemically extracted from the waste of the saw mills and manufacturing plants using pine. This wasted material would fully supply our entire demand, could the process of extraction be perfected. For work on this problem, and for allied problems in wood distillation, the chemical department is supplied with distillation retorts, a refining still, and the necessary accessory apparatus.

But besides wasting wood in these various ways, we allow forest fires to burn every year as much as we use. The annual fire loss, it is asserted by authorities, is actually equal to the annual consumption.

"This large loss is due primarily," states McGarvey Cline, director of the new forest products laboratory, "to the burning of large tops and limbs, called 'slash,' left in logging operations. If, through this new laboratory, there can be discovered some new method of making turpentine, wood alcohol, etc., from such slash, it will not only mean an enormous increase in the value of timber land, but it will also solve the problem of our most destructive forest fires."



TIMBER TESTING LABORATORY IN THE FOREST PRODUCTS BUILDING

Thus, by working out methods for the utilization of the portions of a tree at present wasted, the investigators hope to accomplish a double object. They will not only make useful what is now thrown away, but also by getting this material out of the forests they will avert the indiscriminating and terribly destructive forest fires.

But not only are we to learn to use more of a tree than we use now, we are to learn to use it longer. We want to know how to make timber last longer.

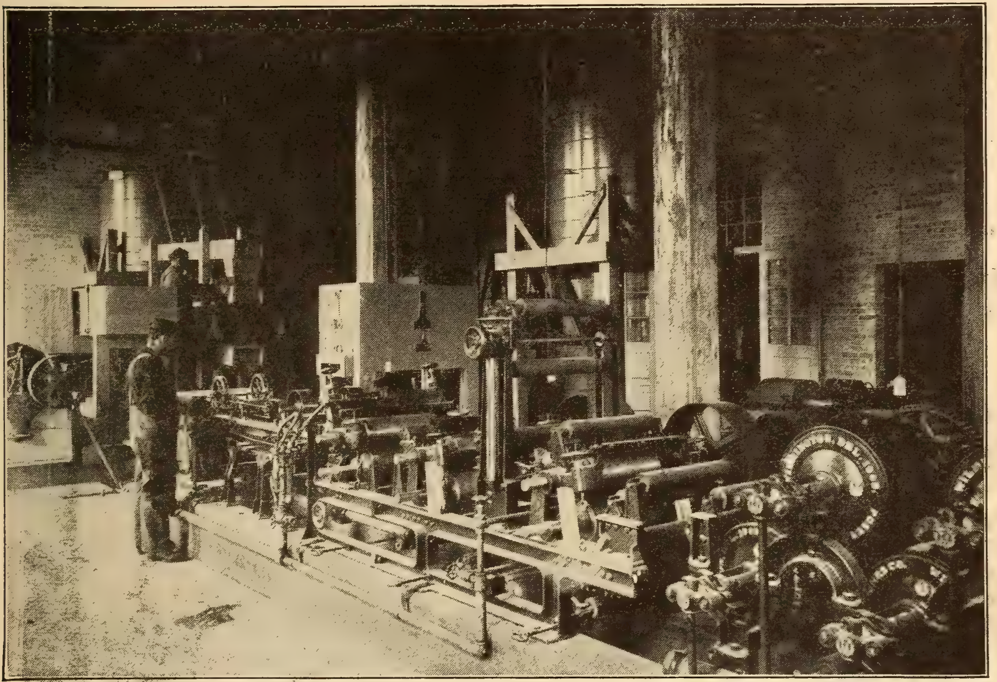
Protecting wood from decay and from the attack of insects has already been shown in certain cases to be practicable. The known range of the process, however, is very narrow. The method of treatment is to force certain chemicals, such as zinc-chloride and creosote, into the wood in large "treating cylinders" at a pressure up to 600 pounds per square inch. It has been already demonstrated that the material treated—such as railroad ties, mine props, fence posts, shingles, and piles—will have its period of usefulness prolonged from ten to eighteen years. Besides increasing the life of the woods now in use, the treatment it is thought may bring into use softer and inferior varieties. Many of these softer grades, which will not last long enough in service to warrant installing them, may be made fit to take the place of the hard grades, at least for the coarser kinds of work. It is possible, for instance, that the great tamarack swamps may yet furnish the main portion of our railroad ties.

By an adequate system of chemical treatment our annual wood consumption could be cut down, says President Van Hise of the University of Wisconsin, by about 12 per cent. That would mean a saving of $72,000,000. The chemistry staff will attack this problem by furnishing artificially the conditions that make decay most rapid. A "fungus pit" is utilized, whose contents are thoroughly inoculated with various wood-destroying fungi, with the humidity and temperature so regulated as to be most favorable to their growth. Wood treated with given preservatives are placed in this liquid. By this means the efficiency of the preservative being tested can be determined under these conditions of forced rotting in a very short interval.

The investigators will by no means confine themselves, however, to the laboratory itself. To save the forest "slash," to control fires, to prevent exposed wood from rotting—these are only the problems which happen to lend themselves to indoor experiment. The results thus experimentally determined will not be considered as final, but will all be tested out on a commercial scale. Experts will be sent out for short periods to the larger mills desiring to co-operate with the Bureau, and under their direction a newly discovered process will be given a trial "life-size."

The lecture courses will furnish a method of spreading information almost equally good. By explaining the history of forest destruction and the present activities of the conservation agitation, the officials hope to create a healthy indignation against waste in all the forms that it assumes. Scientific cutting—felling the selected trees in such a way as to spare the younger growth—allowing to stand an occasional specimen of the desired varieties to serve in reseeding, leaving for further growth those young trees not yet near their maximum usefulness—these are some of the measures of lumbering reform that the forestry workers have been demanding with increasing insistence for several years. The necessity for reforesting less fertile areas, especially mountain slopes where the gullying action of every rain is carrying away the soil so rapidly that any sort of growth at all will soon be impossible—this can be shown to be even more pressing.

Add to these things the recognized urgency of taking steps to *maintain* the existing growth on such of these areas as have not been entirely devastated by wasteful lumbering, and we have material for a course of instruction that may give the great movement for the conservation of our natural resources a very observable and genuine advance.



PAPER PULP MACHINE IN THE FOREST PRODUCTS BUILDING

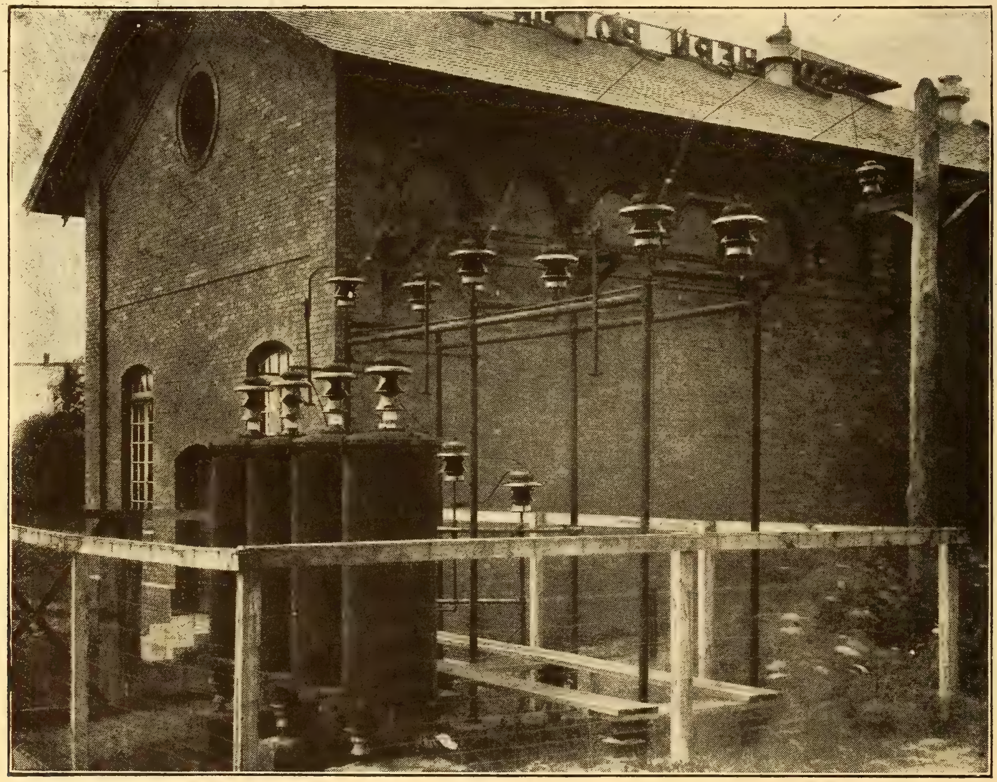
ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

"Safety Valve" for Lightning

Lightning is a discharge of electricity under extremely high pressure or voltage. If its potential could be measured by any device constructed by man it would no doubt be found to reach into the millions of volts. Imagine, then, what takes place when a bolt of lightning strikes an electrical transmission line. The line is designed to carry current at voltages which have so far been brought under control for practical purposes—say 125,000 volts at the outside. Insulators which will carry 125,000 volts safely are as nothing when placed in the way of a lightning discharge, and the latter will jump to earth from the line by the most unexpected paths, starting arcs which the current from the dynamos will follow through, doing great damage.

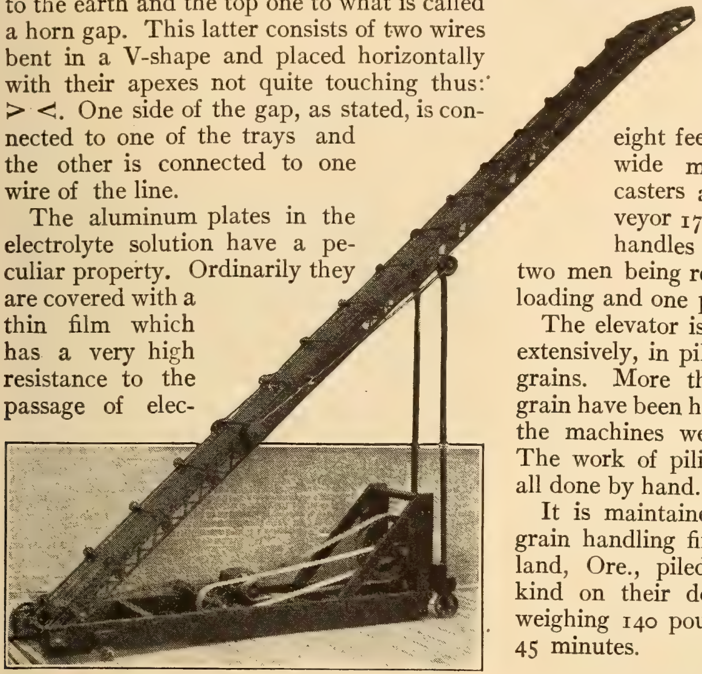
It is customary then, to connect lightning arresters to the line—they are really lightning by-paths or safety valves. One of the most interesting types is the Westinghouse "electrolytic" arrester, which comes the nearest to fulfilling the term electric "safety valve" of any of the various forms. Several of these arresters are shown in the picture, which was taken just outside of a transformer station. Three of the copper power wires are shown in the foreground, entering the building just under the eaves.



AN INSTALLATION OF ELECTROLYTIC LIGHTNING ARRESTERS

The four cylindrical tanks are the electrolytic arresters. Each contains a number of aluminum trays stacked one above another like dinner plates, but insulated from each other and filled in between with a liquid electrolyte. The bottom tray is connected to the earth and the top one to what is called a horn gap. This latter consists of two wires bent in a V-shape and placed horizontally with their apexes not quite touching thus: > <. One side of the gap, as stated, is connected to one of the trays and the other is connected to one wire of the line.

The aluminum plates in the electrolyte solution have a peculiar property. Ordinarily they are covered with a thin film which has a very high resistance to the passage of electric current. When a very high voltage or pressure is impressed upon them, however, greater than the "critical voltage", this film breaks down and current flows freely from one to the next and so on to earth, until the abnormal pressure is relieved. Then the film forms again.



PORTABLE GRAIN ELEVATOR

Now this is what happens when lightning strikes one of the wires: the voltage for a moment is extremelv high and easily jumps across the horn gap to the first tray. If its pressure is high enough to injure the line or electrical equipment it is also high enough to overcome the resistance of the films on the plates and so the surge of current escapes to earth. This flow of current through the trays starts an arc in the horn gap. As the surge of pressure dies down, however, this arc in the gap between the two V-shaped horns is automatically blown out and the line has been relieved before damage can be done.

Portable Grain Elevator

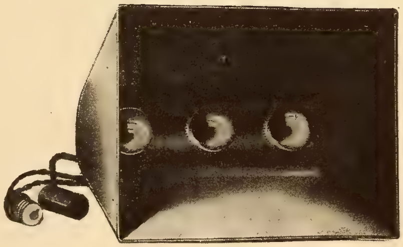
A unique electric driven labor-saving device has been designed for piling sacks as shown in the accompanying illustration. A portable elevator is provided with an electric motor mounted under the conveyor, about two horsepower being necessary for doing the work. The platform is eight feet long and about two feet wide mounted on roller bearing casters and equipped with a conveyor 17½ feet long. This machine handles one ton per minute, only two men being required to operate it, one loading and one piling.

The elevator is used on the Pacific Coast extensively, in piling flour, barley and other grains. More than 50,000,000 bushels of grain have been handled in this manner since the machines were put upon the market. The work of piling the grain was formerly all done by hand.

It is maintained that one of the largest grain handling firms in the world, at Portland, Ore., piled with a machine of this kind on their dock 1,600 sacks of wheat weighing 140 pounds each in one hour and 45 minutes.

A Bath of Electric Light

The Radiotherm, as it is called, is in reality a small, portable electric light bath. Every one knows that it is very healthful to be in the sunlight as much as possible, the sun's rays having a very decided therapeutic value. The Shaler Radiotherm concentrates rays, not of the sun, but of incan-



RADIOTHERM

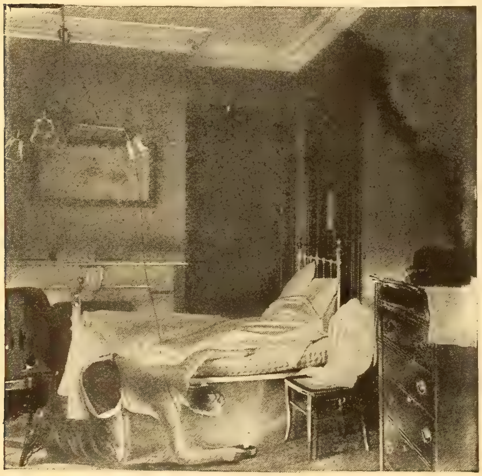
descent electric lamps, directly on any desired part of the body.

Unlike all other devices for applying heat to the body, the amount of heat can be instantaneously increased, lowered, or turned off altogether. This is due to the fact that there are three lamps in the device and that one, two or all of them can be turned on, or they can all be turned off by one motion of the patented four-way switch.

Some Uses of the Flexilyte

In the September issue of Popular Electricity was a brief description of the Flexilyte portable lamp, a handy device by means of which a small incandescent lamp and its conducting cord are arranged somewhat on the principle of the ordinary tape measure, so that the cord may be wound up or let out at will. This makes a very practicable portable lamp, as will be at once appreciated by a glance at the pictures. Aside from reading in bed and looking for pestiferous lost collar buttons there are a hundred other ways in which the little portable can make itself useful. The cord will reach from the lamp socket to a closet, writing desk, dressing table, or cupboard, and give you a light just where you want it.

Storing things away in a closet is easy enough, but to find them is another matter. You may try lighting one match, two, perhaps three, but this carries with it an element of danger. Instead of wasting time and trying your patience, connect a Flexilyte and see how quickly you will find what you are looking for.



LOOKING FOR THE COLLAR BUTTON

Farmers' Telephones

There is no better way to obtain country telephone lines than by organizing mutual companies among the people who actually want and use the telephones. In any cooperative movement of this kind there must be some one who will take the initiative in developing sentiment in favor of the proposition, and who will attend to the details of organization. The usual method is for one or more of the farmers most interested to interview their neighbors on the subject, after having ascertained approximately the first cost of a line, and get them to promise to subscribe either a certain definite amount of money or for a certain number of shares of stock, in case the company is incorporated. After a sufficient number have been interested in the project, the whole question can be easily closed by calling a mass meeting, employing a lawyer to draw articles of incorporation, and inducing each of the interested parties to take sufficient stock in the concern to meet the expenses of construction. Besides the usual officers, it is customary to choose a board of control, which will have the power of making contracts, purchasing supplies and employing expert labor when necessary.

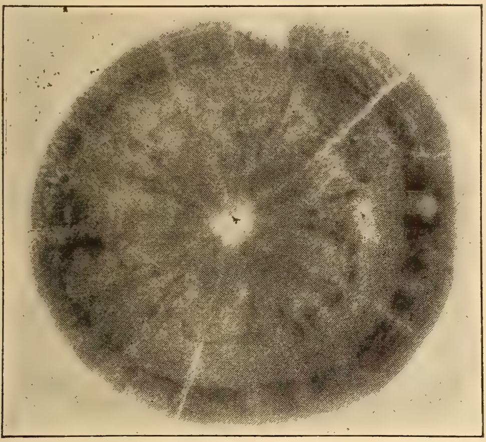
—*Orange Judd Farmer.*

READILY ADJUSTED AT THE HEAD OF THE BED

X-Rays for Examining Petrifactions

By DR. ALFRED GRADENWITZ

The extremely numerous technical and scientific uses of X-rays are known to be based on the differences in transparence shown by the various tissues in regard to these rays. The silhouettes produced by the passage of X-rays therefore give an insight into the internal structure of human and animal organisms, which would otherwise be forever closed to our eyes.



X-RAY PICTURE OF PETRIFIED STARFISH

The latest achievement in this connection is the use of those wonderful radiations in investigating the internal structure of petrifactions, viz., pre-historic organisms converted into a mineral condition. In fact, a French scientist, M. Pierre Goby at Grasse, has recently obtained some excellent X-ray pictures of petrified starfishes, of which a sample is here reproduced.

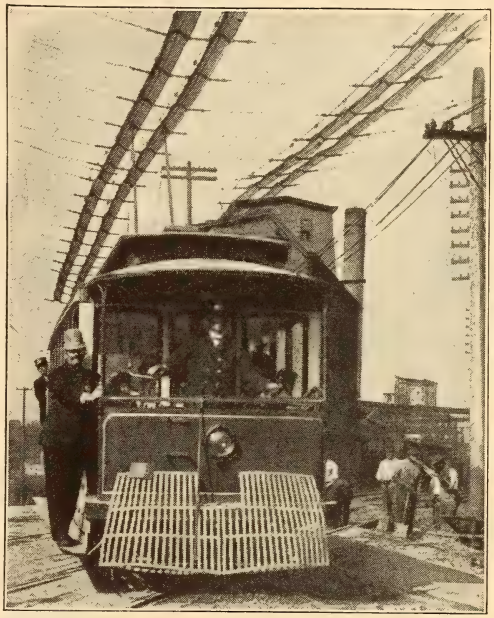
In order to understand the possibility of using X-rays in this connection, it should be considered that all the internal parts of a petrified starfish are filled up by a remarkably homogeneous quartz mass which mainly consists of an agglomeration of minute transparent grains, bound together by a glue so loose as to leave small cavities in the interstices.

Though being little transparent to X-rays, this mineral mass is far less opaque than carbonate of lime, the substance of which the shell of the starfish consists. This is how the X-ray picture of the petrifaction, surprising though this be, absolutely resembles that of a living starfish.

Any slight discontinuity in the various portions of the petrifaction will result in a difference in the depth of shades. The five radial grooves, for example, are distinctly visible and the thinnest portions of the petrifaction, viz., those at the edge, are especially clear. The digestive tube which surrounds the central cavity is seen with remarkable distinctness, each of its circumvolutions being clearly marked.

An Effective Trolley Guard

A street car loaded with people bumps and jars itself part way over a railway crossing and stops. The trolley has been thrown from the wire and a train is approaching. To prevent just such conditions and save life many devices and inventions have been offered. Cincinnati grade crossings are using an effective arrangement shown above the trolley wires in the picture. It consists of an inverted wire mesh trough supported by insulated guy wires. The trough is electrically connected to the trolley wire so that should the wheel leave the wire, current will still be supplied the car until it is safely over. Snow readily passes through the trough and its use has proven most satisfactory.



WIRE MESH TROLLEY GUARD

FOR PRACTICAL ELECTRICAL WORKERS

HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

The Romance of Electric Power

By WARREN H. MILLER

I. LARGE GAS ENGINES

Did it ever occur to you what a very important part the fire grate plays in the power-generating industries of the world?

Aside from water power and the concentrated rays of the sun, our only source of bottled-up power lies in combustible fuel of some sort. Excepting natural gas and crude oil it must all be burnt on a grate of some kind, and the poorer the fuel the larger the grate, until, as soon as you get below a certain grade of fuel, the grate becomes too large and unwieldy to yield anything but a very limited amount of heat, and so we are forced by the grate to abandon the use of vast amounts of combustibles stored up for us by the sun in the form of inedible and worthless vegetable products, peats, poor lignites and all sorts of industrial and agricultural refuse such as used tan-bark and straw.

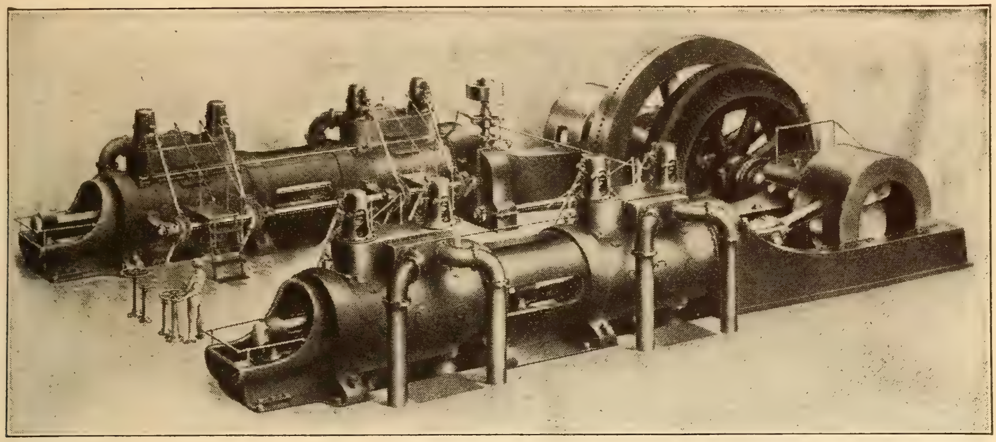
The Germans, who are great students of broad economic questions, have proved in the case of Power vs. the Potato that, except in very special cases, ordinary river water power is worth five times as much in dollars and cents if used in improving agricultural yield than if used for power. There is no denying their arguments or their figures so that the world's future power will tend to economically develop in the lines of combustion,—on a grate.

In the same way natural gas is far too valuable in the general case, as a direct source of illumination, to be used for power, which would be later turned into light through the medium of electricity—so we again arrive at the grate as the logical first step in the generation of the world's power.

After the grate has done its work in gasifying the combustible, you can either turn this gas forthwith under a boiler and generate steam, or you can lead it to a gas engine and explode it behind the piston to get your work out of it direct. Again the grate interferes and sets a limit to the steam engine, especially in moderate sizes of from two to three hundred horsepower, because a too great amount of combustible must be burnt in a short time to generate a horsepower or a kilowatt by way of steam. Wherefore the combustible must be of good quality, such as coal, or else the grate grows out of all proportion to the boiler and becomes unwieldy, wasteful and hard to fire.

The only way out of this dilemma is to *cut down the steam consumption of the engine,* and so we find the modern European superheated steam unit, developed by the scientific genius of the German steam engineer, spreading all over Europe and Europe's trade dependencies in thousands of installations. Our own small steam engines use from 30 to 60 pounds of steam per horsepower-hour:—the German locomobile or superheated steam unit of 75 horsepower uses only *nine* pounds of steam to the horsepower-hour. Therefore the grate need only be one-third or even one-fourth as large as with us;—or, what amounts to the same thing, they can keep our size of grate and burn all sorts of poor combustibles which we couldn't think of using.

One therefore encounters them all over the world in out of the way corners, a Lanz locomobile even as big as 300 horsepower getting along nicely burning plantation refuse in Portugese East Africa; a 2,500 horsepower Wolf installation of three 800-horsepower units running on pampas straw in Argentina; a 200 horsepower unit in Wurtemburg using paper mill waste products; a 125-horsepower plant running on bagasse



A TYPE OF MODERN GAS ENGINE FOR DRIVING ELECTRIC GENERATORS—CAPACITY 2500 HORSEPOWER

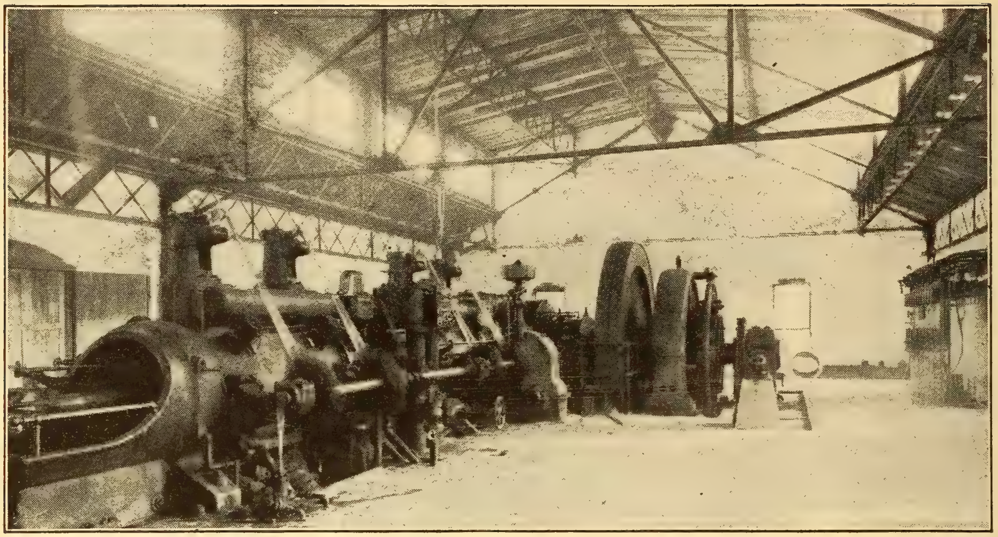
in Cuba; but more of them in a later article—we were talking of grates.

You will note how the careful scientific use of steam, in cutting down the engine-consumption to ten pounds per horsepower, let in all these poor grades of fuel which the grate otherwise kept out. Now a gas producer is really nothing but another form of grate. It may be likened to a poor stove—something that will just give enough heat to gasify everything in the producer, most of the combustible being partially burnt to produce carbon monoxide gas. Here is the ideal grate for a poor fuel. Instead of a roaring white-hot fire such as you want under a steam boiler, the very opposite is required, a slow red fire with just enough heat to drive out all the gases in the fuel, and at the same time to split up the steam and air fed to it into useful hydrogen and oxygen, which combine with the carbon of the fuel to form carbon monoxide and hydrocarbons. If the fire is thin and white hot, steam and air will either be burnt to inert carbon dioxide or will get through unchanged and spoil the gas for the engine. Not only that, but they will start fires inside the producer and either burn up the gas already generated or blow up the whole thing.

With such a slow fire almost anything combustible, can be treated in a producer to yield a good power gas, leading us to the reflection that the logical development of the world's combustible resources would be, and probably will be, to reserve the good coals exclusively for house heating and use all the poor grades and combustible refuse of all kinds for power. Once the conditions are realized that a kilowatt of power costs less from agricultural and industrial waste than from coal hauled hundreds of miles, we may see the cost of keeping us warm in winter drop off somewhat from the present preposterous figures. There are over three million horsepower of absolutely unused gas engine combustibles in blast-furnace and oil-distillate gases alone, to say nothing of agricultural, industrial and civic waste-products

About 3.3 per cent of this is being exploited today in large gas engines, generating electric power.

As all small gas engines using gasoline, city gas, and kerosene are but consumers of a manufactured product which has already used up its share of the world's coal in being manufactured, our interest will rather center on the large horizontal gas engines designed to develop thousands of horsepower from the by-products of the world's coal-consuming industries, and also from the poor and worthless coals and lignites, valueless except when turned into power. Every one knows that a gas engine must do four things to run; fill its cylinder with gas mixture, compress it, explode it, and sweep the cylinder clean of the exploded gas. One can devote four strokes to this, one to each operation as in the four-cycle engine, or you can combine the operations of filling and compressing in one stroke and the explosion and emptying in the other, as in the two-cycle. But the latter cannot be done except with very small engines, and causes considerable loss of

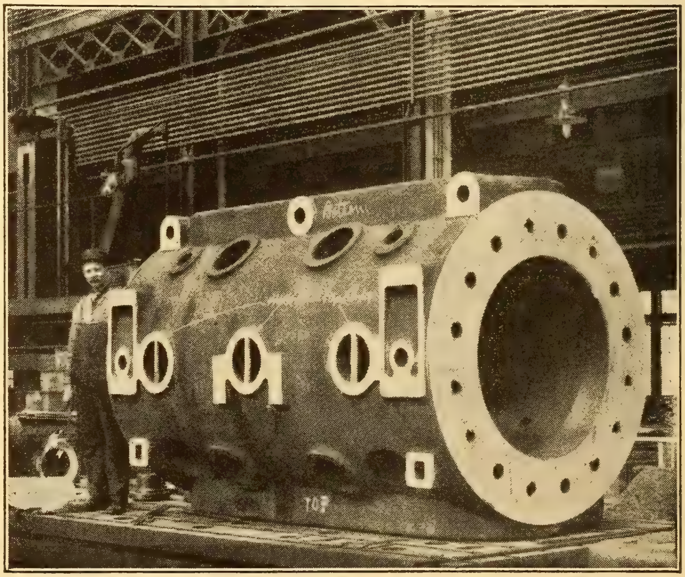


FIVE HUNDRED HORSEPOWER GAS ENGINE AT WORK

power, so that the four-cycle is the only logical type for large gas engines.

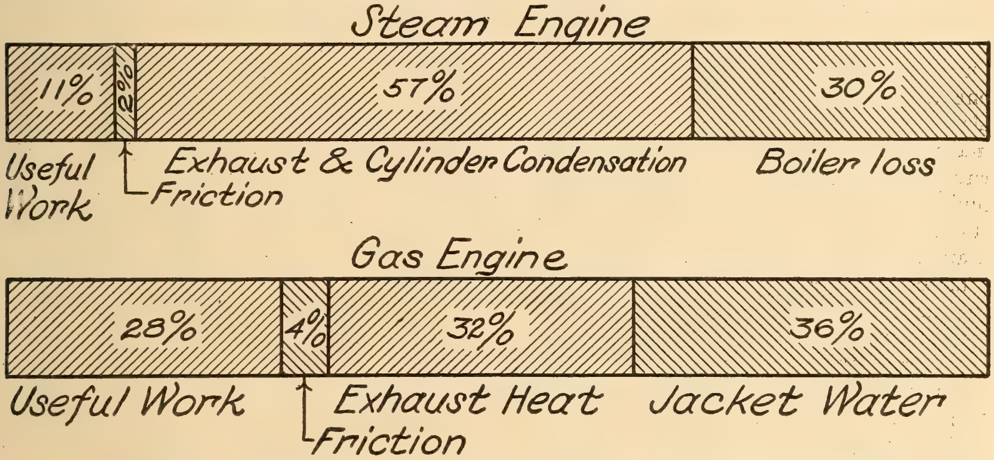
Moreover, it certainly will not do to have only one explosion or power stroke in four, as it makes the engine too irregular to drive alternating current dynamos in parallel, not to mention all other cases where the speed must stay steady. One must have one explosion for each stroke, and to do this the large gas engine invariably takes the form of two double-acting cylinders in tandem. While the head end of No. 1 is exploding its charge, the crank end on the other side of the piston is compressing. In No. 2 cylinder the head end is filling with fresh gas while the piston is sweeping out the exhaust in the crank end. The igniters touch off each one in turn, so that you can readily see that the crank end of No. 1 which was compressing is the next one to be set off, making the return stroke. This stroke sweeps out the exploded gases in the head end of No. 1, compresses the gas in the head end of No. 2 and fills the crank end of No. 2 with fresh gas. Just make a little picture of the two cylinders and this system of events will become entirely apparent. The series of ignitions is followed out in regular rotation, giving a very uniform speed under steady load.

But as the load fluctuates, often violently when driving street railways or industrial plants, some means of governing the force of the explosions must be provided. It is obvious that the "hit-or-miss" system of small gas engines, where the charges are fired or not at the fourth stroke, depending



SHOWING THE SIZE OF A GAS ENGINE CYLINDER upon the general speed of the engine will not do, as this introduces quite wide variations in angular flywheel speed. Alternators in parallel are so closely tied together electrically that a variation of only about one-third the width of a stator slot is the maximum permissible, say ⅛ inch in a rotor ten feet in diameter. Yet this is the very form of electrical service that the gas engine is wanted for, particularly in the future, for only by alternating current can the power be distributed far and wide around the location of the source of waste gas or waste combustible. For this reason the very best engineering brains of the world have been turned upon the governing of gas engines driving alternators in parallel.

The "hit-or-miss" was discarded in favor of throttling the mixture at a certain point, combined with variable lift of the inlet valves, both being controlled by the governor. In other makes this was replaced by control of the mixture directly at each of the four inlet valves by a movable-port valve. At present America leads the world in this form of gas engine governing, the proportions of gas to air being fixed approximately constant by the sizes of the gas and air ports in the valve and the opening of these is varied simultaneously at all four inlets, by the governor as the load changes.



COMPARISON OF THE RELATIVE ECONOMY OF STEAM AND GAS ENGINES

If the load is very light you can readily see that the governor will shut these ports to mere slits, so that the mixture will not remain of the same proportions due to friction along the port edges and the engine will miss and become very irregular at light loads. As every mis-fire is generally followed by a back-fire somewhere in the exhaust piping, an engine will often be thrown completely out of parallel on light loads and all the engines in the power house will be booming like siege-guns while the electric instrument needles go wild. To avoid this, the very latest designs of large American gas engines have the governor designed to vary, not only the opening of the ports, but the *time* also that they remain open during each stroke, so that the ports are never shut very much even on light loads, as the time cut-off also advances simultaneously with the closing of the ports.

The cylinders are now made of cast steel by the most advanced firms, as it has all along been quite a problem to make these huge tubes strong enough in cast-iron to withstand the shock of explosion and yet thin-walled enough to allow the jacket-water to cool the cylinder walls properly.

As made today the American horizontal gas engines stand at the head as prime movers for driving alternating current dynamos in parallel.

Meanwhile on the electrical side of the problem, the best scientists of America and Europe—men like Steinmetz at home and LeBlanc in France—have worked out the *kind* of alternator best adapted for gas engine drive. The design must provide for something to resist all tendencies to throw the alternators out of parallel. If an engine misfires or prematures, its whole load is immediately transferred to the other engine in parallel with it, and it itself becomes a drag on the powerhouse. The governor of the other engine instantly opens wide, while that of the back-firing engine closes, because it for the moment has thrown off its load and tries to speed up. The other engine, with wide open governor soon has too much gas because the first one is taking back all the load, being too fast, so it in its turn speeds up, while the other, gorged with all the load, slows down. This swinging action is known as "hunting," or surging in parallel.

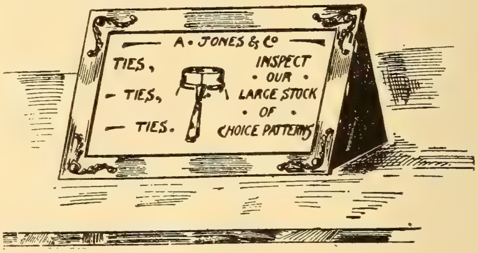
The best cure for it is the electric "damper" or amortisseur as the French call it. The damper usually takes the form of a complete "squirrel-cage" winding, built into the revolving field of the alternator by running heavy copper rods through holes bored in the steel pole-pieces and joining these rods by copper rings at each end. This makes the revolving field in effect also the rotor of a simple induction motor the stator being the stator of the alternator. As you may know, an induction motor always drags behind the cycles of the alternating current and is therefore the best anti-hunting device. Now if one engine tries to speed up, its frequency also rises, so that the damper on the slow machine must drag behind it, whence the engine which is trying to get fast will have to pull the other one with it,—which at once slows it down. The damper thus acts automatically to resist *any* changes of speed. So long as both engines are going along nicely, the dampers take no part at all in the game, but, let one engine try to get even a fraction of an inch ahead of the other,—presto! the damper of the other machine instantly drags behind and discourages it.

The amount of combustible available for gas engine power is so vast as to be almost incomprehensible. For every ton of coke burnt in smelting pig iron in the world's blast furnaces, 750 horsepower is available for outside sale and distribution; for every barrel of refined oil in the world's oil-yards, four horsepower are liberated in oil distillate gas. After these come all the world's solid combustibles in the order of gas-producing capacity per pound as follows:—Coke, 104 cubic feet; bituminous coal, 75 cubic feet; lignite or brown coal, 55 cubic feet; turf, peat, 45 cubic feet; wood, 35 cubic feet, including all the by-products of the lumber, bark, cane and agricultural industries. These are all available for gas-producer service, and as to the comparative heat losses of steam and gas engines our illustration gives a very graphical comparison.

(To be continued.)

A Flashing Counter Sign

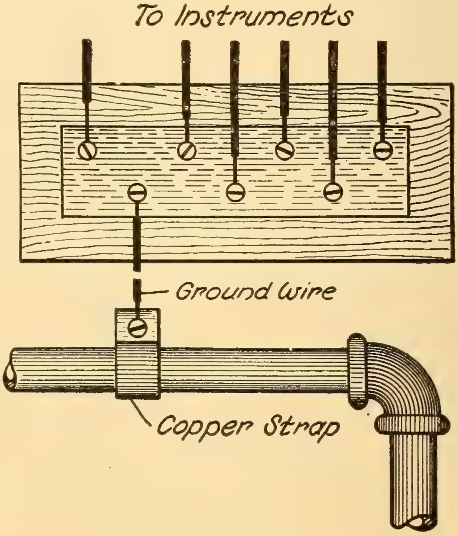
Just why an unexpectedly illuminated sign will attract one's attention more than adjoining larger and perhaps prettier ones, is a matter that the psychologists will have to explain. For the practical storekeeper the one great point is that these electric signs do catch the customer's eyes whether they want to look or not. A simple variation from the usual types is in the shape of an easel with enclosed sides and with the glass front slid into place so that it can be exchanged for others. In this way the same outfit can be made to advertise a variety of different items alternately, the only added expense being for the painted glass slides.



FLASHING SIGN FOR SHOP COUNTER

Handy Ground Block

It is often desirable in laboratory work to be able to make a ground connection. The accompanying illustration suggests a plan for



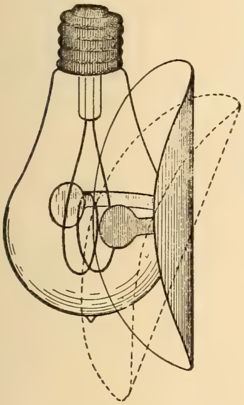
HANDY GROUND BLOCK

doing this. Take a piece of sheet brass about 1 by 4 inches and bore several 3-16-inch holes in it for round-headed brass screws. Fasten this plate to a hard wood block on the wall and connect to a water pipe if possible. Any instrument that you wish to ground may then be easily connected by wire under one of the screws of the ground plate. This device should be used only where very small currents are involved and if possible a slate block provided in place of the wood.

FRED S. WALKER

Adjustable Lamp Shade

An ingenious shade for use on incandescent lamps is here shown. It consists of a metal disk bent into a semicylindrical form and provided at opposite sides with spring clamps adapted to press against the lamp globe, holding the device in position. As can be seen the shade may be fastened in any position so that the shadow is cast in any desired direction. This arrangement will be found especially useful for hospitals and sickrooms, enabling the nurse to protect the patient's face from the direct rays of light yet leaving other parts of the room illuminated. By painting the interior of the shade with white enamel it may be used to a certain extent as a reflector also.


ADJUSTABLE LAMP SHADE

Hint on Making a Small Rheostat

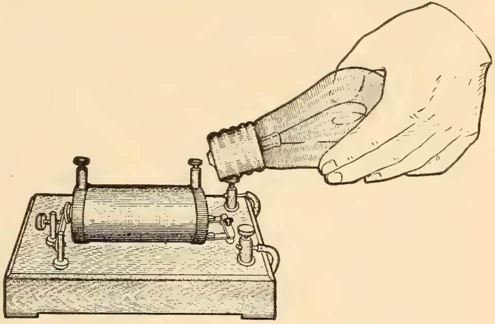
As resistance wire is somewhat expensive and quite frequently amateurs in electricity need a good resistance in some experiment I might suggest that they look about the house for one or more curtain shade rollers that have been discarded. Inside the roller will be found a nicely wound metal coil whose resistance is high and which will stand considerable heating by current. One can arrange these coils on porcelain knobs or tubes to his own liking and so build a rheostat at little cost.

G. H. DALTON.

Testing Lamp Vacuum

In the patents granted Mr. Edison in 1879 the incandescant lamp is described as consisting essentially of a high resistance carbon filament hermetically sealed in a nearly prefect vacuum.

When this vacuum becomes low the lamp begins to waste energy. You have no doubt found the globe of one lamp very hot while another near it was only slightly warm. The first lamp is losing its vacuum, the air within the lamp affording a means of transmitting heat from the filament to the bulb. The illustration shows a simple means of determining how good the vacuum is by using as small as a one-half inch induction coil. If in a dark room a lamp is held in the hand and brought nearly or quite in contact with the secondary post of the coil no effect is noticeable if the vacuum is good. If a low vacuum is present a bluish or yellowish haze will fill the bulb.


TESTING LAMP VACUUM

Vat for Electroplating

A well made vat of oak may last for 12 or 15 years if it be smeared inside with the following mixture:

Burgundy pitch	1,500 parts
Old gutta percha in shreds	250 parts
Finely powdered pumice stone	750 parts

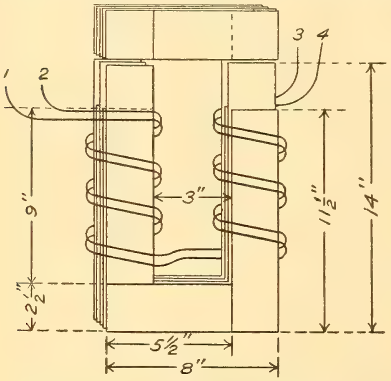
Melt the gutta-percha and mix it well with the pumice stone. Then add the Burgundy pitch. When the mixture is hot smear the inside of the vat with it, laying on several coats. Roughness and cracks may be smoothed off with a hot soldering iron. The heat of the iron makes the cement penetrate the pores of the wood and increases its adhesion. The vat will stand sulphate of copper baths, but not baths of cyanide.

E. BERTHOUD.

Construction of a Tesla High-Frequency Apparatus

Many requests are received for information on the construction of a Tesla coil and transformer to go with it. As this requires specific directions of some length we believe it advisable to reprint the article by Mr. H. L. Transtrom which appeared in the January, 1909, issue of Popular Electricity. This article contains all the information necessary to construct a coil and transformer with which to perform the usual high frequency experiments such as lighting a sixteen candle-power lamp one terminal of which is held in the hand and the other connected to one terminal of the Tesla coil, the production of fantastic brush discharges, the melting of fine wire by high frequency current passed through the body, lighting of a vacuum tube, etc. The outfit may also be used for medical work and wireless telegraphy. Following is a description of the apparatus:

A transformer is needed, giving 10,000 to 20,000 volts to charge the condenser. To construct one it is necessary to make a core from soft sheet iron strips, with a cross-section 2½ inches square, built in the shape of a rectangle eight by fourteen inches outside dimensions and three by nine inches inside (see Fig. 1).



Connect No. 2 and 4 together for series connection and for parralell No. 1 & 2, And also 3 and 4.

FIGURE I. TRANSFORMER FOR HIGH FREQUENCY WORK

Cut from the sheet iron, strips 2½ by 5½ inches and 2½ by 11½ inches, a sufficient number to make a mass five inches thick of each size when compressed in a vise.

Then take three strips at a time and build a core of the dimensions given in Fig. 1, leaving the top section unfinished until the secondary coils are placed in position.

To hold the core in shape after it is assembled, take two pieces of dry wood twelve by three by 1½ inches and bore a hole in the ends of each, nine inches apart. Put one board on each side of the bottom section and place in a vise, when the six-inch bolts can be drawn tight and then the core will be rigid.

On the vertical sections wrap tightly two or three layers of friction tape to within 2½ inches from the top. Over this wrap a couple of layers of Empire cloth.

The primary consists of 110 double turns wound in a single layer over the Empire cloth, the conductors being two No. 12 cotton-covered copper wires placed side by side, 55 double turns on each vertical section (see Fig. 1).

Over the primary winding next wind tightly 15 layers of No. 7 Empire cloth nine inches wide and we are ready for the secondary winding.

In winding the secondary much care must be exercised, as a transformer's insulation is no better than its weakest spot. This secondary consists of 20,000 turns of No. 32 single cotton-covered copper wire wound in eight coils of 2,500 turns each, which are connected in series, four coils on each side.

The coils are rectangular in shape 1¼ inches wide, four inches square inside and six inches square outside dimensions. They are wound on a form 1¼ inches wide and four inches square, the lateral edges being slightly rounded off to facilitate winding. This form is carefully centered and a metal rod about six inches long of any convenient size is passed through, with a small crank fastened on one end. To keep the coil from sliding out of shape make two disks seven inches in diameter, and when centered screw one on each side of the form.

Set this form between two supports and begin winding, first a layer of Empire paper and then a layer of wire alternately, until the 2,500 turns are on. It will be found very easy to wind this fine wire in layers if it is allowed to slide over a rod a foot or so away and guided with one hand while winding with the other. Leave a margin of $\frac{1}{4}$ inch in each layer.

All coils should be tested to see if there are any bare places or if the wire is in one continuous piece. If not, do not attempt to use it as it will surely burn out when run a short time. When all coils are completed they should be dried in an oven, not too hot, and then laid flat in hot petroleum and boiled for several hours, and then left to cool in the mixture until set, which will take quite a long time.

When thoroughly cold, take carefully out of the mixture and after taking the surplus off the coils, assemble on the core over the primary, four on each side. To keep the coils insulated from each other, cut 36 squares of Empire cloth seven by seven inches and cut out of their centres a hole that will fit snugly over the Empire cloth on the primary. Use six thicknesses between adjacent coils, there being only six places to use these separators.

The coils should all be connected in series as though it were one continuous wire beginning at the top of one section and ending at the top of the other. (See Fig. 1.)

Connect all coils so that they have the same relation to one another as the turns in the primary. Keep the coils one inch from the bottom of the core by inserting narrow strips of birch wood across the binding boards and cover with several thicknesses of Empire cloth.

When all the coils are assembled and connected properly, the top part of the core may be completed. A sheet of micanite nine by four by 0.1 inches should be used to separate the vertical sets of coils. Make a box of close-grained hardwood seven by fifteen by fourteen inches inside measurements and coat thoroughly with hot paraffine to make it perfectly tight.

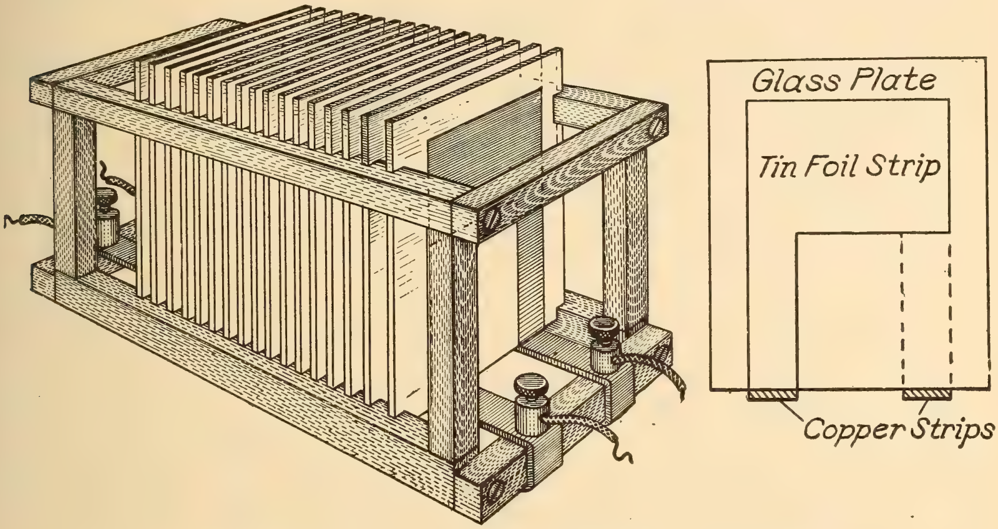


FIG. 2—CONDENSER FOR HIGH FREQUENCY APPARATUS

When the transformer is set in the box it may be fastened by screws to the bottom binding boards.

Bring the ends of the primary wires to one side of the box and the secondary to the other side where they can be connected to proper binding posts. The secondary wire should be kept clear from the core and be led out through hard rubber rod binding posts. The four primary wires should be arranged so that they can be easily connected either in series or parallel.

Boil 40 pounds of extra amber petroleum and fill the box to the top and screw fast the cover and the transformer is complete.

Next we construct an adjustable condenser of seventeen plates of double thickness window glass ten by twelve inches. Coat all the plates with tin foil five by six inches on both sides. Leave a margin of two inches on top and sides and five inches on the bottom. On eight of these plates paste a strip of tin foil on the lower right hand corner to reach the bottom and on the other nine paste them on the lower left hand corner of the foil. These are the connectors which rest on two copper strips laid parallel four inches apart on the bottom of the crate with binding posts on each end. The strips are fastened on and insulated from the bottom of the wooden crate, with slots in the sides to receive the plates. (See Fig. 2.)

The Tesla coil consists of a primary of seven turns of No. 6 bare copper wire and a secondary of 180 turns of No. 22 bare copper wire wound in a single layer on a drum six inches in diameter and fourteen inches long made of dry birch boards glued together in a circle and then turned off in a lathe. The turns of wire are carefully spaced apart 1-16 inch when winding, leaving a margin of ½ inch on the ends. The primary is wound on a wooden drum eight inches in diameter and 4½ inches long, the turns being carefully spaced apart and fastened. The secondary coil is set on top of the primary coil and the base fastened to the bottom drum.

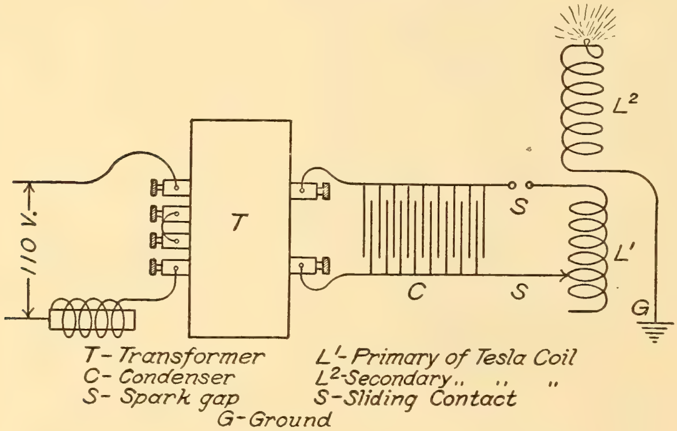


FIG. 3. CONNECTIONS OF TESLA OUTFIT

Give the secondary winding a coat of orange shellac, being careful not to disturb the turns while doing so. A nice turned top can be added for appearance, and a brass rod four inches long and ⅜ inch thick driven tightly in the centre of the top and well rounded off, will be the discharge rod, being connected to the top end of the secondary wire.

The lower end of the secondary terminates in another binding post.

On the primary a binding post is fitted at only the upper end, while the other connection is a sliding contact.

For a spark gap take a glass jar about six inches in diameter and eight or ten inches in height and make a hole in the bottom ¼ inch in diameter. To do this take clay or putty and lay a thick layer over the centre of the bottom of the jar. Make a ¼-inch hole in the clay down to the glass and fill with hot solder. The glass will fall out the shape of the hole in the putty or clay.

Make a cover from some nice hardwood to fit tightly in the top of the jar, and bore a hole in the centre, in which fasten securely a threaded ¼-inch nut which is connected by a wire to a binding post on one edge of the cover.

A ¼-inch rod threaded the whole length is fitted with a hard rubber handle ¾ by three inches long. This is screwed in the threaded nut. The length of rod depends on the height of jar used. Another rod is fitted with a metal ball ¾ inch in diameter and inserted in the hole in the bottom and then through a base of hardwood on which a binding post is placed.

Now to operate the completed apparatus connect as per diagram, Fig. 3.

Connect the lower terminal of the secondary of the Tesla coil to a good ground with stranded wire, as a stranded wire is a better conductor for high frequency currents than is solid wire.

Although good results can be obtained by using the primary in parallel on 110 volts, 60 cycles, consequently 20,000 volts secondary voltage, yet as good results with better control may be had by using the primary sections in series and an adjustable choke coil in series with them. The choke coil can be made from a mass of sheet iron 2½ by 2½ by eight inches, which is inserted in a hollow coil of No. 10 copper wire of 110 turns.

By inserting the core in the coil the current can be varied according to the depth inserted. This outfit is for the uni-polar or single pole method of generating high frequency currents. If all connections are correctly made the spark gap should be turned until the spark will just jump easily, then on the primary of the Tesla coil move the sliding contact on the second turn from the top, then onto the next turn and so on until the desired results are obtained.

To light a lamp use the fourth or fifth turn and slide the lamp along the side until the brightest light is obtained.

Always disconnect the primary of the transformer before attempting to adjust the different parts.

By adding condenser plates or taking them out of the crate, one by one, the coils will be brought in tune under certain conditions.

How a Farmer Secured Electric Lights

W. H. Neville, of Vista Farms, Edison, Pa., by the exercise of a little ingenuity and using second-hand apparatus constructed a very satisfactory electric light plant at small cost. He sends us the following description.

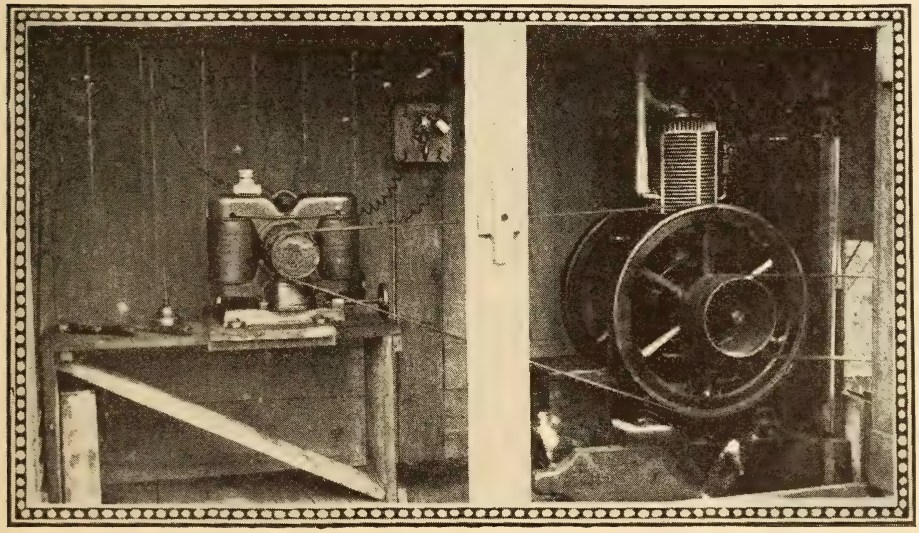
"A two and one-half horsepower gasoline engine was already in use. A second-hand, one horsepower, 110-volt shunt-wound motor was purchased and belted to the engine and used as a dynamo, as shown in the picture. By running the motor fifteen per cent faster than its rated speed it lights to full brilliancy sixteen, sixteen-candlepower lamps. One gallon of gasoline will run the engine over five hours. so that the cost per light is but one-fifth of a cent per hour. Kerosene lighting used to cost me more.

"The pulleys on the engine are so arranged that I run the engine to pump water, saw wood, churn, etc., so that I figure the lighting as costing nothing when other savings in labor are considered. No storage battery is used so there is the inconvenience of having to start the engine each time light is needed but I am amply repaid by having plenty of light and no oil lamps to handle and care for.

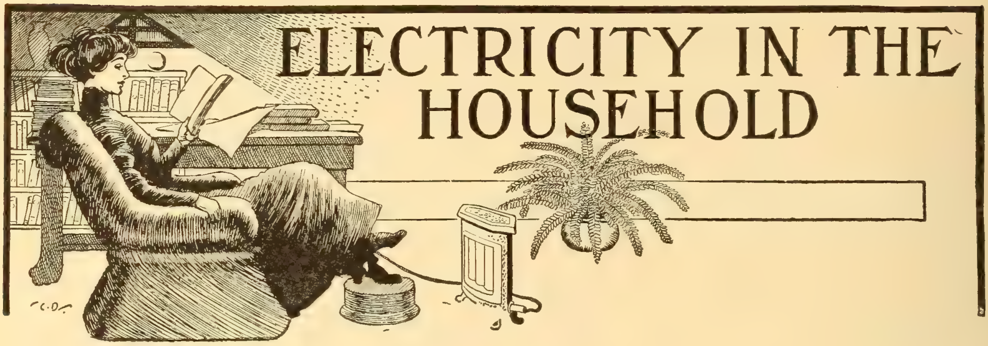
"The engine and generator require hardly any attention and an old motor such as I use can be purchased for as low as fifteen dollars. By rewinding the starting box with a fine gauge resistance wire I made a good field rheostat."

A Potato Polarity Indicator

That ordinary vegetable, the potato, may be used to tell which is the positive and which the negative terminal of a circuit. Insert the two current carrying wires into the freshly cut surface. A green stain due to dissolved copper indicates the positive wire. If both wires are surrounded by dark-colored stains the current is alternating.



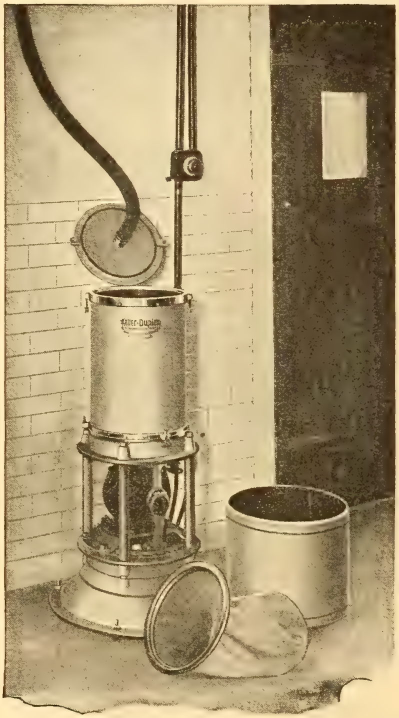
ELECTRICAL GENERATING SET FOR FARM USE



ELECTRICITY IN THE HOUSEHOLD

Permanent Vacuum Cleaning System

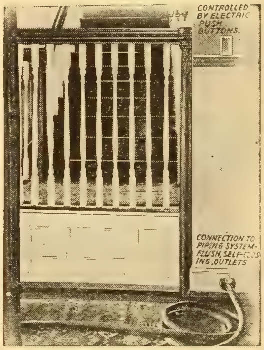
The time is approaching when arrangements will be made in building a house for a vacuum cleaning system the same as for the heating, lighting and plumbing systems. A little piping will be necessary, but not nearly so elaborate as for the heating and plumbing which are now recognized necessities.



PERMANENT VACUUM PUMP AND MOTOR IN THE BASEMENT

One way of acquiring this most desirable adjunct to a modern home is by the use of what is known as the Keller-Duplex system, which is shown in the illustrations.

In the basement is located the machine for creating a vacuum in the system of small pipes which lead to the various rooms of the house. This part is stationary, and the little motor which operates the pump is connected directly to the lighting circuit in the basement, being started and stopped by ordinary snap switches located on all floors. The air which is drawn down through the system of pipes is passed through muslin bags in the vacuum creating chamber and all dust and dirt so removed.


CONTROLLED BY ELECTRIC PUSH BUTTONS.
CONNECTION TO PIPING SYSTEM-FLUSH, SELF-CLOSING, OUTLETS

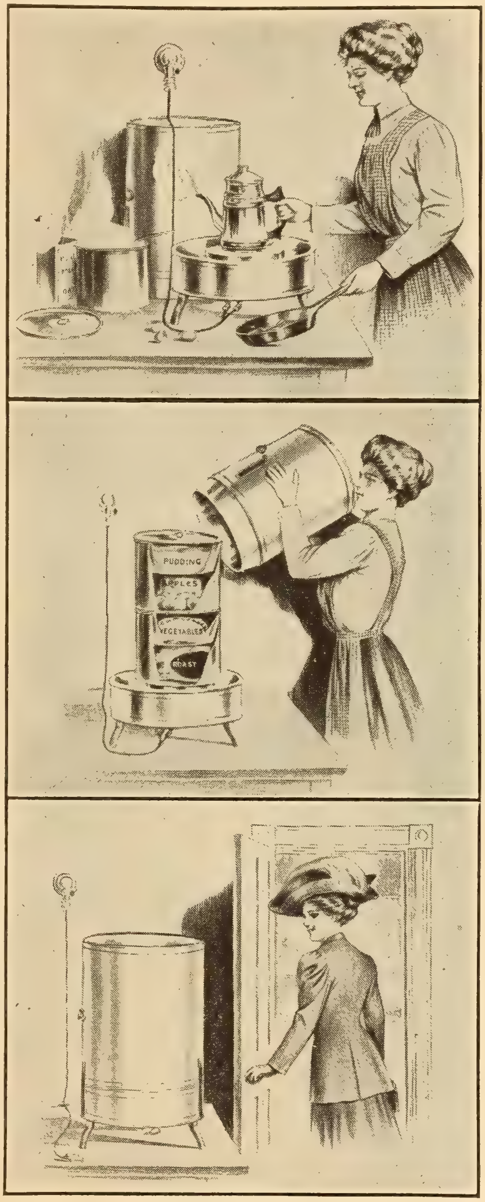
SHOWING CONNECTION TO INLET

Up stairs, all that is visible of the system is a small inlet in the base board, to which the hose is connected. The hose is plenty long enough to reach to all parts of the room and the usual "tools" are provided for cleaning carpets, rugs, draperies, curtains, etc.

The pipes for the system range from 1½ to one inch in diameter and so are readily run through partitions and between floors.

ELECTRIC FIRELESS COOKING

To many people the term "fireless cooker" is an apparent self-contradiction. It sounds like saying a "wingless bird," or an "unfrozen icicle." Nevertheless there are such things as fireless cookers which effect considerable economy. They are devices for keeping food in a state of being cooked after the process of cooking has been properly started either over a fire or by means of electric heat. Such a cooker consists essentially of a containing receptacle which will not allow the heat to escape from the steaming hot ingredients, once they are put inside.



One of the newest departures in this line is known as the Quad electric stove and fireless cooker. It embodies all the advantages and economies of electric cooking with those of the fireless cooker.

The illustration shows clearly the method of operation. In the upper picture the housewife is preparing the breakfast. This is done on the small electric disk stove which is placed in the bottom of the cooker proper. The cereal is already cooked and the coffee, bacon and eggs are in the process of preparation for the breakfast table.

At her right hand is the fireless cooker which by means of an air-tight, beveled rim fits down into the base which holds the stove. While the breakfast is being prepared or at any time during the morning work the various dishes may be prepared for the noonday meal. These find places in the various compartments of the fireless cooker as shown in the middle picture. These may be set going as soon as the breakfast is out of the way, for fireless cooking is a slow process, and nothing is wasted in steam or vapor, and there is no burning of a dish, which is always a possibility where an oven is used. When the vegetables, roast, etc., are all in the cooker and the cover clamped down, the current is turned into the stove, which remains in the bottom of the cooker, and left on for a short time until everything is at cooking temperature. Then, owing to the non-conducting sides and bottom of the cooker the heat is retained and the cooking process goes on.

The one who has presided over these operations may then go out, to do her shopping without fear of coming back to an oven and kitchen full of smoke. If a hurry call comes in to put off dinner for a half an hour it causes no consternation, for the things will come out of the cooker at the end of that time and be just as good.

Sweeping, Beating and Dusting in One Operation

Some of the most painstaking housekeepers maintain that it has been and always will be necessary to beat carpets, shake rugs, sweep thoroughly and then dust. In other words they do not feel things are being cleaned unless they can "see the dust fly."

For this reason they very likely have not taken readily to the quietly operating vacuum cleaner. Perhaps however, they have never seen the Hoover suction sweeper in operation, which not only embodies the vacuum cleaning principle but also that of the ordinary carpet sweeper.

SWEEPING AND DUSTING AT THE SAME TIME

These principles are all embodied in the design shown in the illustration, which consists of but five parts—the motor, the fan, the brush, the case and the bag. The suction is created by a fan driven at a speed of 3,400 revolutions per minute, by a compact but powerful Westinghouse electric motor, which also operates a revolving soft hair bristle brush at high rate of speed. These elements, in their operation combine the three cardinal principles of cleaning: vibration, formerly accomplished by beating and shaking; brushing, formerly done, ineffectively, with the broom and carpet sweeper; suction, the gathering and holding of all the dirt after it has been dislodged.

The initial cost of the electric suction sweeper and the cost of the current necessary to operate it are very insignificant when compared with the time and expense, and the personal worry and fatigue connected with the old fashioned method of house cleaning. Besides, a sweeper of this kind keeps the home clean, not once in a while, but all the time, and not partially but absolutely clean.

Automatic Batteries for House Lighting

Portable storage batteries now so commonly used for operating the ignition system of automobiles, and giving about 60 ampere hours at six volts, have found many uses besides that for which they were primarily intended. For instance, in the home of the maker of one of the well known types of battery, the Jewel, extensive use is made of the current derived from two of these batteries.

One of the batteries is placed upon a shelf in the basement, and connected with fourteen tungsten lamps of various sizes from two to ten candlepower, and within each of five closets are lamps in oval reflectors, these lamps being connected with burglar alarm springs on the closet doors, in such a way that when the doors are opened and closed the lights are lighted and closed off automatically.

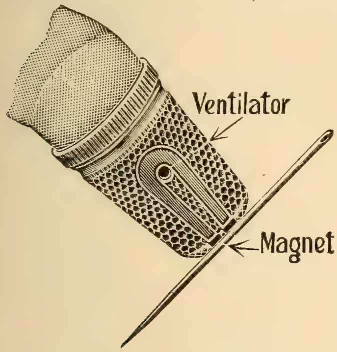
Also above the five mirrors are lamps, and on the piano is a lamp in an oval reflector. In the bedrooms eight-candlepower lamps are used to furnish light for retiring, and in the basement a ten-candlepower lamp is used when coaling the furnace, etc. This battery is also connected with a jump spark coil, which ignites the burners of the kitchen gas stove, and also to operate a system of burglar alarms, electric door chimes, electric fans and electric cigar lighters.

The other battery is used for the operating of a vacuum cleaner, and sewing machine, and massage vibrator. There is also being constructed for this residence an electrically lighted and operated water spray fountain for the parlor.

About every two weeks one of the batteries is taken out to be re-charged. The cost of re-charging a "6-60" battery, is only fifteen cents. Where central station current is not available such a system is satisfactory and economical.

Magnetic Thimble

An ingenious novelty in the form of a magnetic thimble is shown in the cut, the object being to enable one to pick up a needle readily without getting out of temper. A little horseshoe magnet is fastened to the thimble, the ends projecting slightly beyond the end but not interfering with the ordinary use of the thimble. This department is edited by a couple of men and far be it from them to pass upon the practicability of the device. But it will pick up fish-hooks and there is no reason why it should not work on needles.



A MAGNETIC THIMBLE

"Electricity in the Service of Woman"

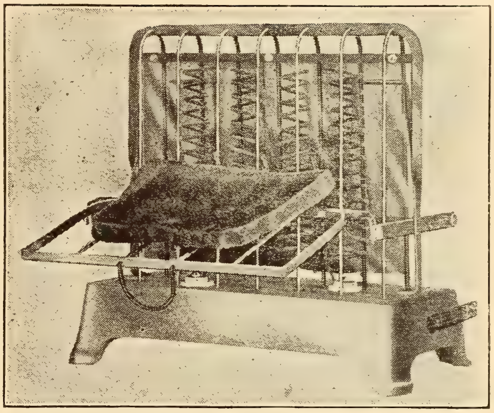
Twenty years ago one of the best electrical books available for the general reader was Urbanitzky's "Electricity in the Service of Man," an 800-page volume of which repeated editions were issued both in German and in English. In giving it this title, the author evidently thought of electricity as serving mankind in general, although the contents are devoted almost entirely to the industrial uses which benefit the average person rather indirectly. The well illustrated volume did include medical batteries, incandescent lamps and telephones which even at that time were invading the homes and making their appeal to women, but outside of these three items it was practically a man's book.

The electric heater that takes the chill off my lady's dressing room in the morning, the thermal pad that warmed her feet last night, the electric curling iron and vibrator that help preserve her beauty; the hair drier that relieves part of her toilette making of its wearisomeness; the coffee urn, toaster and chafing dish that make her breakfasting a joy; the washing machine and electric sad irons that lighten the household work; the vacuum cleaner that leaves no need for the terrors of spring cleaning; the fan motor that insures baby's sleep or mother's comfort even on the hottest days—all these have come since Urbanitzky wrote and revised his memorable book.

To describe and picture these and a score of other electric devices of interest to housekeepers with the same clearness would make fully as large a volume on "Electricity in the Service of *Women*." Is it not time that some man showed his gallantry as well as his thoughtfulness by treating this theme in an adequate volume?

The "Cozy" Toaster

Among the more recent portable devices for cooking by electricity is the Phelps Cozy toaster which prepares a slice of bread just to your liking for a cost of only one-twelfth of a cent a slice. It toasts two slices at a time, one on each side. The heating element is practically indestructible, and the toaster presents a handsome appearance. There is a little hinged holder for the slice which, when turned up and fastened in place, holds the slice near the red hot wires but not touching them.



A NEW ELECTRIC TOASTER

JUNIOR SECTION

An Electrical Laboratory for Twenty-Five Dollars

By DAVID P. MORRISON

PART XII.—SOME SIMPLE EXPERIMENTS

All magnets have the power of attracting toward them any magnetic material that may come into the region surrounding the magnet, which is termed the magnetic field. This magnetic field is then a region in which magnetic forces exist and its strength at any point will depend upon the strength of the magnet producing it and the distance the point considered is from the magnet. This magnetic field will have a definite direction at any point and this direction is determined by the direction a north magnet pole would tend to move when placed in the field at the point. If a compass needle were placed in the field the north pole would point in the direction of the field.

Place a good size bar magnet on top of a piece of paper as shown in Fig. 108. Now take a very short steel needle and magnetize it and arrange to support the needle by a piece of very fine thread so that it is perfectly free to turn and well balanced. The direction of the magnetic field surrounding the magnet at any point can now be determined by the small magnet or compass needle and marked on the paper with a pencil. If the compass needle be carried from one of the magnets to the other, and its position marked for a number of different points, and a line drawn through all these points, corresponding in direction with the position of the needle at the point, the line will correspond to what is termed a line of force. Any number of different paths may be taken by the needle and a line drawn for each path. The position of these various lines with respect to each other will be similar to that shown in Fig. 109.

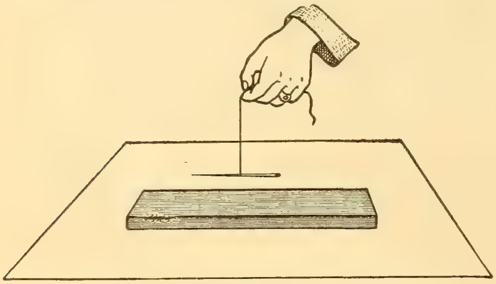


FIG. 108. DETERMINING THE DIRECTION OF MAGNETIC FIELD

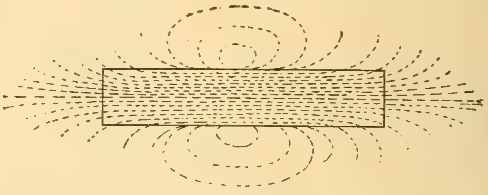


FIG. 109. MAP OF LINES OF FORCE

The above method of mapping out the magnetic field of a magnet will be found to be very tedious and the following method will be much easier and it will require a great deal less time. Place the magnet whose field is to be investigated under a sheet of heavy paper or cardboard and sprinkle some rather fine iron filings on the paper, tapping the paper at the same time. The iron filings will arrange themselves in curves corresponding in direction to the magnetic field. Such a field is shown in Fig. 110.

These imaginary lines, called lines of force, always start from the North Pole of a magnet and terminate at the South Pole. If a magnetic substance be placed in the field of a magnet the field will be distorted or changed. The lines of force per unit area will be a great deal greater through the magnetic substance than through the air. This is on account of the substance being a better conductor of magnetism than air. If, for instance, a piece of iron be placed in the field the result will be similar to that shown in Fig. 111.

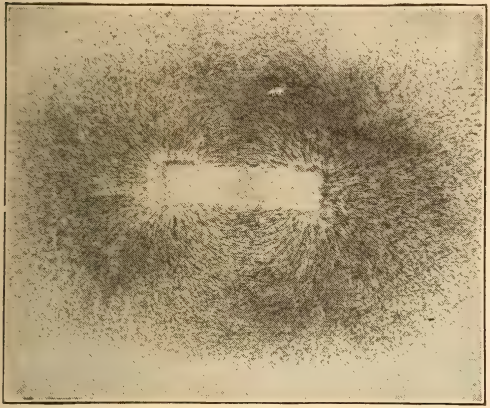


FIG. 110. IRON FILINGS IN MAGNETIC FIELD

The arrangement of the lines of force existing between the opposite poles of two magnets is shown in Fig. 112. It can be seen that the lines pass between poles of opposite polarity. When the like poles of the magnets are presented, the lines no longer pass from one magnet to the other but pass around and terminate at the opposite pole of the same magnet, as shown in Fig. 113.

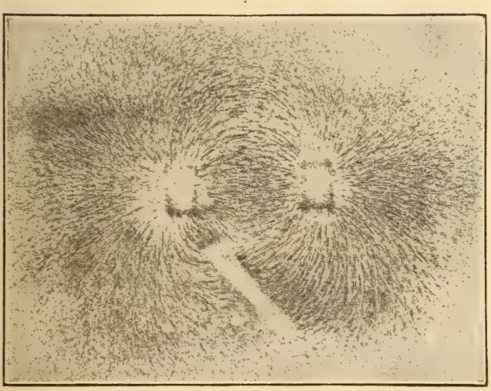


FIG. 111. PIECE OF IRON IN MAGNETIC FIELD

To preserve the field as shown by the position of the filings upon the paper, take the sheet of paper the field is to be formed on and dip it in some hot paraffin and then hang it up by one edge and allow it to drain and cool. The field can now be produced on this sheet of paraffined paper. After all the filings are arranged as you want them, and without moving the magnet or paper, take a hot soldering iron or poker and hold it over the paper which melts the paraffin and allows the filings to sink into it, and they are as a result held in place when the paraffin cools.

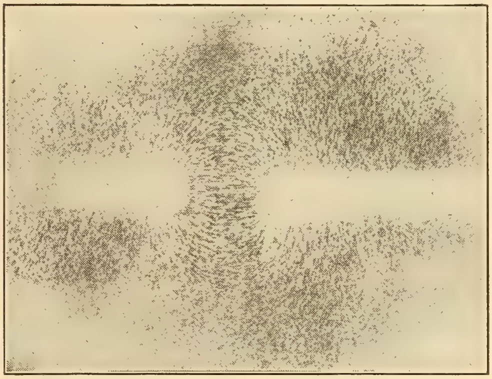


FIG. 112. ACTION BETWEEN OPPOSITE POLES

Another simple experiment that serves to show the direction of a magnetic field may be performed as follows: Obtain a shallow vessel, preferably glass, and of rather large diameter. Place in the bottom of this vessel a permanent bar magnet and

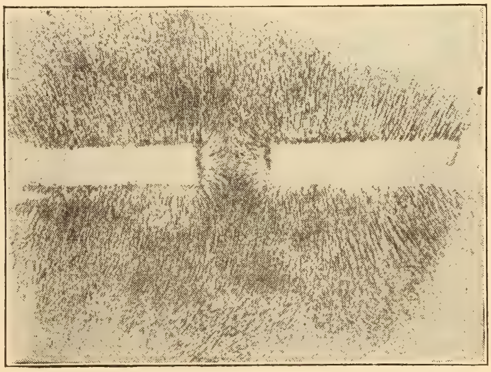


FIG. 113. ACTION BETWEEN LIKE POLES

cover it with water to a depth of about one inch. Now magnetize a steel needle several inches in length and put it through a cork in such a way that it will float in a vertical position, when the cork is placed in the water, see Fig. 114. First, however, determine the polarity of the needle and arrange to have the lower end the North Pole. When the cork and the needle are placed in the water they will move, due to the magnetic field of the permanent magnet upon the North Pole of the needle. The cork will follow a curve similar in form to one of the lines drawn in Fig. 109 and it will pass from the North Pole of the permanent magnet to the South Pole.

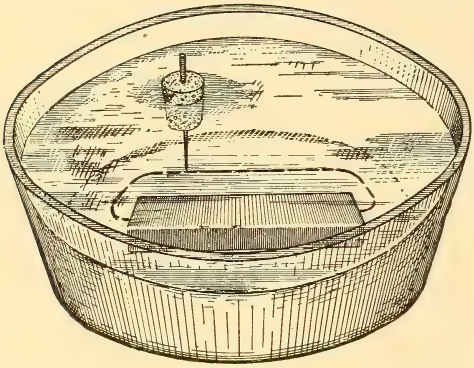


FIG. 114. FLOAT SHOWS DIRECTION OF LINES

This experiment can be made to appear very mysterious in the following way. Magnetize a short piece of steel and imbed it in a piece of cork so that the magnet itself is not visible. Obtain a steel rod about one foot long and ¼ inch in diameter and magnetize it by means of a powerful electro-magnet if possible. After the bar has been magnetized it may be placed inside of a wooden tube and the ends covered in some suitable way. With this wand the cork can be made to move in the dish in any way you choose. You can hold the dish in one hand while you are performing the experiment and the results will be entirely dependent upon your movement of the wand. Give the wand to some one and at the same time place the dish on a table with a strong magnet under the cover on the table. Have the pole of the magnet that is under the table, of the opposite polarity to the lower end of the magnet in the cork. When this is the case the cork will be held in a position directly over the magnet under the dish and if this magnet is very strong there will be practically no change in the position of the cork produced by any movement of the wand.

Here is another experiment. Obtain a small quantity of iron filings and place them in a shallow dish. Now get a piece of very soft iron about ¼ inch in diameter and six inches long. Place one end of this piece of iron in the dish of iron filings and withdraw it. There will be no iron filings adhering to it. Place the end of the piece of iron again in the dish and present one end of your wand to the other end of the piece of iron and withdraw the end of the iron rod from the dish of filings still holding the wand near the other end. When the wand is placed near the piece of iron the latter becomes magnetized due to the process of magnetic induction and as a result attracts the iron filings.

The magnet produced by the process of magnetic induction has a polarity just the same as any other magnet and this polarity can be determined by presenting one end of the bar, in which the magnetism is induced, to a compass needle. The polarity thus determined will bear a definite relation to the polarity of the permanent magnet that is inducing the magnetism in the iron bar. It will be found that by marking the polarity of the magnets that the pole of the induced magnet nearest the end of the inducing magnet will be of opposite polarity to that end of the permanent magnet.

Magnetism is supposed to be due to a molecular condition of the material forming the magnet because a magnetic needle when heated red hot is found to lose its magnetism completely, and if a magnet is jarred or hammered or twisted, the ability of the poles to pick up particles of magnetic materials is greatly diminished. Again, if a magnet be broken into a number of small parts, each part is found to possess two magnetic poles. The subdivision may be continued indefinitely but always with the same result that two poles are formed at each break.

Fill a small glass tube with iron filings and magnetize the tube by stroking it with a magnet. This magnetized tube will then produce an effect on the ordinary compass needle the same as that produced by any magnet and from all outward effect it is itself a magnet. But it will lose its magnetism as soon as the filings are shaken up. You can magnetize the tube with your wand, present it to the compass needle and the needle will be affected. Hand the tube now to another person and in doing so give it several good shakes. The person to whom the tube was presented, much to his surprise, will be unable to cause it to produce any effect upon the compass needle.

Another interesting experiment that might be called magnetic writing can be carried out as follows: Round off the end of a piece of steel and magnetize it as strongly as you can. Now with the end of the magnet write on a piece of thin steel such as a saw blade and then sprinkle with iron filings. The writing, which is quite invisible in itself, comes out in the lines of the filings that stick to the magnetized parts. This writing will continue in the steel for a considerable time, depending of course upon the treatment of the piece of sheet steel.

In making magnets some care should be exercised in selecting the material for the magnet. All kinds of steel cannot be used in making permanent magnets, although they may possess good machine tool properties. Certain grades of steel that contain a certain percentage of manganese cannot be magnetized. Some brands of mild plate steel, spring steel, and cast steel can be readily magnetized, but they do not retain their magnetism permanently. Select a piece of good close-grained rolled steel and cut from it a piece whose dimensions correspond to those of the magnet you want to make. This piece of steel should now be bent into its final form and finished with a fine file. Temper the piece glass hard by heating it to a moderately bright red temperature and then plunging it into a bath of water or preferably oil. The piece of steel can now be magnetized as follows, often called the "single touch" method and the proper procedure for carrying out this method is shown in Fig. 115. The dotted line indicates the path the end of the magnet used in magnetizing the bar should travel in. A better magnet will be obtained by magnetizing each half separately as shown in Fig. 116.

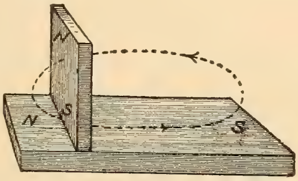


FIG. 115. MAGNETIZING BY "SINGLE TOUCH"

Oftentimes there is no permanent magnet available to be used in magnetizing your bar and the magnetism of the earth may be utilized. If the bar to be magnetized be placed as near as possible parallel to the earth's magnetic field, the north end dipping down, and in this position be struck a number of times with a piece of wood, it will be found to have acquired magnetic properties.

If a number of turns of insulated wire be wrapped around a piece of steel to be magnetized, and a strong current of electricity be passed through the coil from a battery as shown in Fig. 117, the bar will be permanently magnetized with a North and a South Pole, after the current is turned off. Tapping the bar while the current is turned on will increase the strength of the magnet formed.

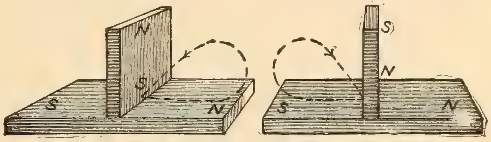


FIG. 116. MAKING A MAGNET

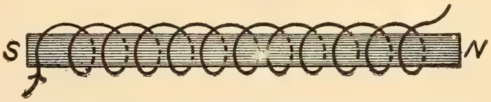


FIG. 117. MAGNETIZING WITH AN ELECTRIC CURRENT.

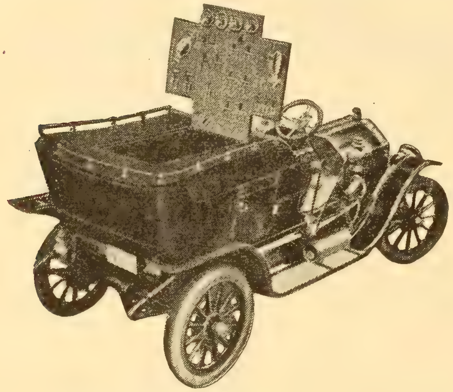
The coil may be wound on a wooden form and any number of bars magnetized by simply slipping them into the coil, which eliminates the trouble of winding and rewinding the coil for each magnet. If a soft piece of iron were placed in the coil it would lose its magnetism as soon as the current was turned off. This fact is used in what might be termed a silent telegraph instrument which consists of a piece of soft iron surrounded by a coil of wire and mounted over a small box of fine iron filings. These filings are attracted to the bar of iron when there is a current in the coil of wire surrounding it and they are released when the current ceases to flow. The coil can be connected in a telegraph circuit in the place of the ordinary sounder. A sheet of white paper placed over the end of the bar of iron will add greatly to the ease of determining whether the filings are attracted to the bar or not. The duration of the time the filings are held by the bar corresponds to the dots and dashes of the code you use.

(The End.)

An Electrical Laboratory on Wheels

The management of a system of evening schools in New England has devised a very novel method of furnishing electricity for the use of the students.

Four specially designed automobiles made with an enclosed tonneau are used to transport the apparatus from place to place. Under the chassis is suspended a two-kilowatt, direct or alternating current generator, driven by the same gas motor that propels the vehicle itself. Wires lead to part of the tonneau cover which when opened up forms a good sized switchboard. Connections are made to the board and students have the benefit of a complete laboratory outfit. The automobiles are also equipped with a 200-mile wireless station so that it is possible for the schools to be in communication with each other at all times.



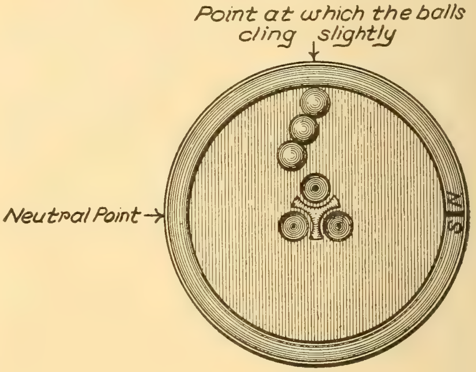
LABORATORY READY FOR USE

An Electrical Fishtale?

Smiles were abundant among readers of the last number of the Swiss "Technische Blaetter," a serious technical journal, on account of an article in the same purporting to be based on experiments made by a Frenchman named Rose. The article stated that Rose dipped the terminals of a dynamo into a stream in which dace or darts (a small variety of fish allied to our familiar minnows) were plentiful and that the current strongly attracted the little fish to the positive pole; in fact, they were so forcibly drawn to it that if this positive wire had been barbed they would have been speared alive! Perhaps there is some action of the current on fish of which we are not yet aware, but with all due regard to the never ending wonders of electricity, does not this report sound rather fishy?

A Magnetic Puzzle

Every year brings new varieties of the "Pigs in the Clover" type of puzzle in which a series of balls or marbles is to be placed simultaneously in one or more pockets. Among the more recent of these is one which depends on magnetism for its tantalizing qualities. It consists of an aluminum case not much larger than a silver half dollar, with a glass cover and with three steel balls which are to be manipulated into three pockets at the center of the case. This would be simply a matter of careful tilting were it not for a circular magnet which lines the rim of the case and to which the steel balls persistently cling. Moreover the pockets are separated by little ridges or fences which so increase the difficulty of getting the balls into them simultaneously as to spoil the most logical solution of the puzzle.



MAGNETIC PUZZLE

In a circular as in a horseshoe magnet the greatest attractive strength is at or near the ends and the neutral point (or point of no attraction) would be opposite the split part of the magnetic ring. The natural inference therefore would be that if the puzzle is tilted with this neutral point uppermost, the balls will easily leave the magnet to which they cling even at this neutral point because (being of hardened steel) they have themselves become slightly magnetized. But anyone trying the puzzle soon finds that while the balls are easily tapped off this neutral point, they will roll off independently and separate too far to be caught in the pockets; for the moment a ball gets near the rim again, it is drawn to the same. The really logical point of detachment for the balls is one where the attraction is not as strong as at the poles, but still strong enough to let the balls magnetize each other and thus cling closely together while they are being manipulated into the center by tilting and tapping the casing.

Telephone Helps Save Forests

The enormous fire loss in the forest reserves of the United States during the year has caused considerable discussion as to the best means of prevention and has also raised the query as to the protection now available.

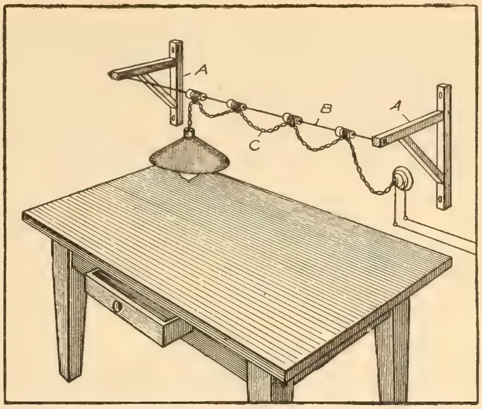
Five years ago ex-Chief Forester Pinchot caused telephones to be installed in connection with the patrol system. Immediately after a fire made its appearance aid was summoned over the telephone and the fire stopped before it was beyond control. Many lives and thousands of dollars' worth of lumber have thus been saved. Formerly the ranger after discovering a fire was obliged to ride to the nearest settlement for assistance, during which time the fire would probably get beyond control. Up to the present time 600 miles of telephone wires have been strung and enough use made of the telephone to show that it is of the greatest value in the forestry service.

An Adjustable Bench Light

A work bench light which can be readily located where required is a very necessary part of a shop equipment especially during the winter months.

A light that can be shifted along the entire length of the bench is shown in the accompanying illustration. Two brackets (A) either of wood or iron may be placed on the wall above the bench and a wire (B) stretched tightly between them. String four small porcelain tubes or knobs on this wire and to these tape the flexible cord to the light. An attachment plug or a rosette may be used where connections are made to the circuit and a cord adjuster will serve to raise and lower the light.

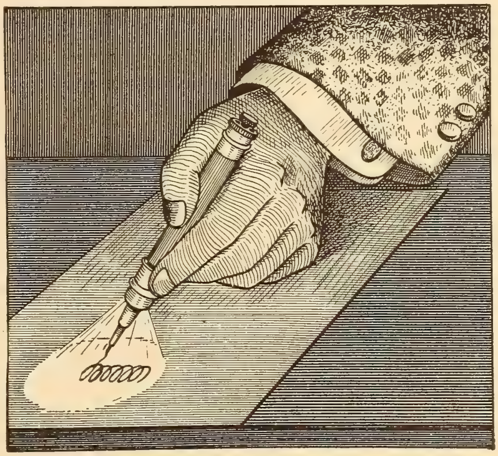
W. M. Kishpaugh.



WORK BENCH LIGHT

Writes by Its Own Light

An architect desires to make a note of some defect in the dark basement of a building, an author to record a sudden midnight inspiration, the sleuth to sketch a plan on the spot; in fact many instances arise where the electric pencil shown in the sketch would be useful in giving a little light and that only where needed. By turning the screw at the top the light is switched on. When the pencil attachment is removed the device may be used like the ordinary pocket light. In designing a novelty of this kind the battery could be placed in the barrel of the pencil and one of the very small "grain of wheat" lamps which are made for dental purposes, etc., could be used.



COMBINED PENCIL AND LIGHT

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine will be devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART VIII.—A TWO KILOWATT CLOSED CORE TRANSFORMER

Some perhaps may wonder why I describe the construction both of a transformer and an induction coil in a series of papers which are supposed to deal with the equipment of one station only.

The transformer is employed only where alternating current is available. By its use the always troublesome interrupter is avoided and it is possible to use larger currents at a greater efficiency. But even though the induction coil is somewhat less efficient and more expensive to construct it cannot be condemned, for it must be remembered that it often plays its part where a transformer would be out of the question. For example, in portable outfits or isolated stations it would be impossible to supply a transformer with alternating current unless a cumbersome engine and dynamo were at hand.

While a detailed description of the design of transformers cannot well be given here I will undertake a brief discussion of some of the fundamental principles and factors entering into the design.

Transformers exist in two different forms, known as the open and closed core types. The first is much like an ordinary induction coil connected directly to an alternating current system without any form of interrupter.

The induction coil which has been previously described would operate as an open core transformer but is somewhat less efficient than the closed core type of transformer which consists of two independent coils of wire wound upon an iron ring or rectangle. When an alternating current passes through one coil known as the primary it generates a magnetic flux which in flowing through the other coil induces in it an electromotive force. The magnitude of this secondary electromotive force is almost directly proportional to ratio of the number of turns in the windings. For example, if it were desirable to raise the voltage of a 110-volt circuit to 22,000 volts, the number of turns in the secondary must be about 200 times those in the primary winding, providing the transformer is of good design.

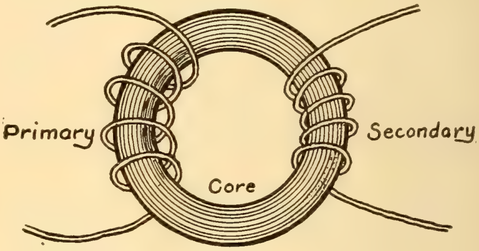


FIG. 91. SIMPLE TRANSFORMER WITH RING CORE

A transformer having a core which is ring-shaped as in Fig. 91 presents several theoret-

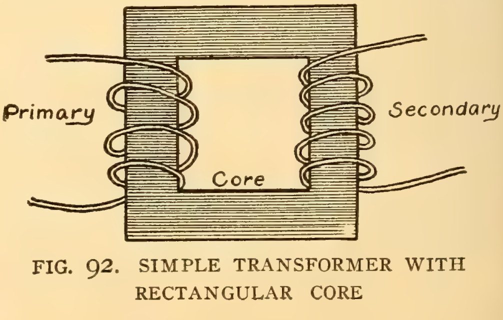


FIG. 92. SIMPLE TRANSFORMER WITH RECTANGULAR CORE

ical advantages as such but would be exceedingly difficult to construct. The core is therefore usually given a rectangular shape as in Fig. 92. In a well designed transformer the primary and secondary are usually divided into two halves and one wound on each "leg." This has the advantage of requiring considerably less wire to attain a given number of turns since they are all closer to the core. It also reaches another result which is somewhat more important. The greater part of the magnetic lines of force generated by the current flowing through the primary surge through the iron circuit but part of them pass also through the air immediately around the primary and core. The magnitude of the current induced in the secondary is dependent upon the number of lines of force which it cuts. Thus we see that by splitting the coils and winding one over the other it is possible to raise the efficiency considerably.

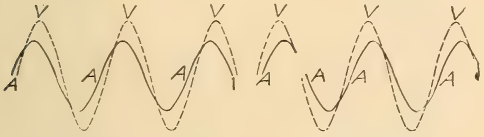


FIG. 93. ILLUSTRATING LEAD AND LAG IN PHASE

In considering however a transformer designed to give high potentials from the secondary we must take into account the insulation between the primary and secondary. Perfect insulation is much harder to secure when the coils are wound over one another. Not only this, but the fact that the transformer is to be used for wireless telegraphy where a condenser is shunted across the secondary also puts a difficulty in the way.

When an alternating current is passed through a circuit containing either inductance or capacity it does not always keep step with the alternating voltage impulses. The effect of capacity, which is the relative ability of the circuit to retain an electrical charge is opposite to that of inductance which may be defined as the property of the circuit whereby lines of force are developed around it. If there is capacity in the circuit there will be a lead in phase, while if there is inductance the current will lag. Fig. 93 illustrates this. The figure at the left shows the lead produced by capacity and the one at the right the lag due to inductance. The curves (A) and (V) represent respectively the current and the voltage.

We may more readily see the influence of these two factors if we imagine the high tension oscillation condenser to be connected directly to a source of alternating current of high potential. The current of course charges the condenser, and its voltage since the current is alternating ranges from zero to its maximum, say 25,000 volts, then from this back to zero, from zero to minus 25,000 and back again to zero. This is called a complete *cycle*. During this period the condenser twice takes energy from the circuit and twice on every cycle returns it.

But if a spark gap and a sending helix are bridged across the condenser it will discharge through the helix and across the gap at least four times per cycle.

Mechanical work is measured by a unit called a horsepower, which is equivalent to 33,000 pounds raised one foot high in a minute of time. Raising the same weight the same distance in two minutes would be exercising only one-half horsepower. Likewise if we are able to increase the number of discharges per cycle of the alternating current not only will more energy be drawn from the line but more energy will be transformed into oscillations and go forth as waves into the ether. The station will then have a greater transmitting range.

To return to the relation of the impulses of the charging current it may be said that the effect of the condenser is to cause the current to lead as we have seen in Fig. 93. That is, the proportionate instantaneous values of the current occur sooner than the voltage values and are always greater. This is why the condenser is able to give energy back again to the line every half cycle.

If an inductance coil consisting of a number of turns of large copper wire wound around an iron core is connected to a source of alternating current it will likewise draw energy from the line and return it every half cycle. But in this case the proportionate instantaneous current values are always smaller. By properly proportioning the amount of inductance and capacity it is possible for them perfectly to neutralize one another and the proportionate values of the amperage will correspond to the instantaneous voltage values the same as in an ordinary direct current circuit. Then it will be impossible for energy to be returned to the line and the power factor of the apparatus will be materially increased.

A wireless transformer does not ordinarily have enough inductance itself to bring about this result and so it is usual to insert an impedance or reactance coil in the circuit by placing it in series with the primary of the transformer.

Much the better way, however, is to so construct the coil of the transformer so that it gives rise to magnetic leakage and the inductance of the primary is increased thereby.

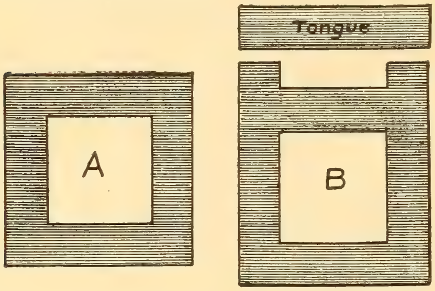


FIG. 94. TWO FORMS OF CORE FOR PRACTICAL PURPOSES

Such construction precludes the possibility of arcing at the spark gap and allows the electrodes to remain cool. Freedom from arcing means that the frequency of the discharge is considerably increased and so while the efficiency of the transformer is not quite so high, when used as a wireless transmitter *more* energy is actually sent up into the aerial to be transformed into electromagnetic waves.

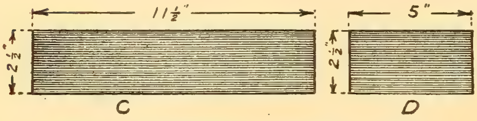


FIG. 95. STRIPS FORMING CORE

By constructing the core as in (B), Fig. 94, these results are attained. By varying the size of the air gaps or by varying the number of turns in the primary it is possible very closely to regulate the form and amount of current.

CORE

The iron core is made of the best soft transformer iron obtainable. In lieu of this the stovepipe iron sold at plumbing shops may be used but is not to be recommended.

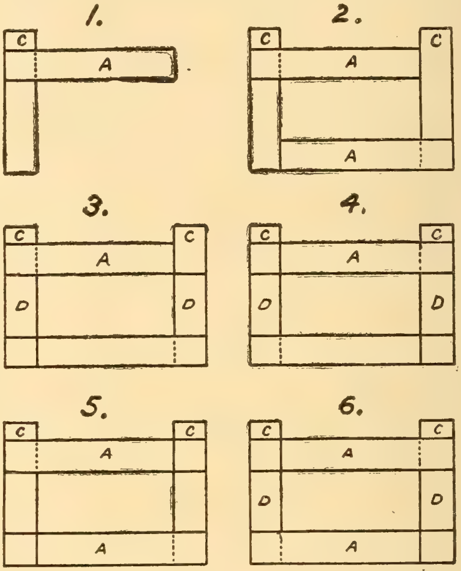


FIG. 96. STAGGERING STRIPS

About 80 pounds will be required. It should be as thin as it is possible to obtain it. Strips $2\frac{1}{2}$ inches wide are cut from the sheet and dipped in some such insulating varnish as P. and B. or M. I. C. compound. About two quarts of the varnish will be required to cover the iron. It is well to thin it with some gasoline so that the coating will be thinner and more iron can be gotten into the core. If the iron sheets or laminations were not insulated from each other in this way the effect would be the same as if the core were solid and heavy currents of electricity known as *eddy currents* would be set up therein and considerable energy would be lost in heat resulting in a general lowering of the efficiency of the transformer.

After the varnish has thoroughly dried the strips are cut up as shown in Fig. 95 into lengths of five, $11\frac{1}{2}$, $12\frac{1}{2}$ and fifteen inches long. Enough strips are cut off the five, $11\frac{1}{2}$ and fifteen inch sizes to form a pile of each $2\frac{1}{2}$ inches high when compressed. A pile five inches high of the $12\frac{1}{2}$ inch sizes are required. The core is fifteen inches long and $11\frac{1}{2}$ inches wide without the tongue. The legs are each ten inches long and are separated from each other by a space of five inches.

The strips are staggered in assembling in the manner illustrated in Fig. 96, so that a solid core with no air gaps save at the short ends projecting beyond the primary leg is the result.

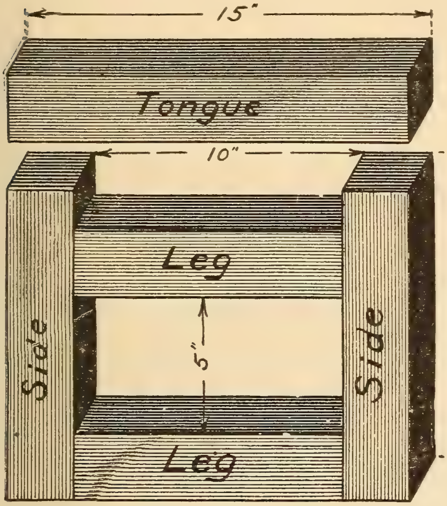


FIG. 97. CORE COMPLETE

The core is squared up by knocking in any strips of iron which project. It will then appear as in Fig. 97. The primary leg is wrapped with two or three layers of empire insulating tape or well-varnished linen preparatory to winding on the primary wire.

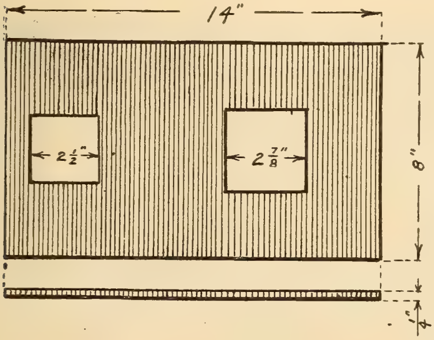


FIG. 98. FIBRE HEAD

Two fibre heads eight inches wide and fourteen inches long are cut out of a sheet one-fourth of an inch thick. Two square holes are cut in each in the position indicated in Fig. 98.

Twenty layers of No. 6 Empire linen in the form of a strip ten inches wide are wound over the secondary leg of the transformer. Empire cloth is obtainable at almost any electrical supply house. It is made of a closely woven fabric, which has been coated with films of pure oxidized linseed oil. The result is an insulator of high electrical resistivity and considerable mechanical strength. No. 6 is six thousandths of an inch thick and has an average puncture voltage of 7,800. This part of the transformer serves to insulate the secondary from the core and must stand the greatest strain. It is therefore not good policy to substitute doubtful insulation.

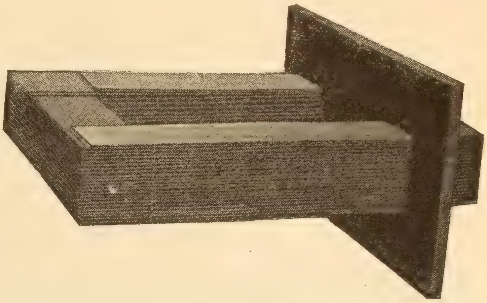


FIG. 99. CORE WITH HEAD SLIPPED ON

One side of the core is then pulled out so that a fibre head may be slipped over the legs as shown in Fig. 99. It is well to place two clamps on the core at the other end when removing the side.

(To be continued.)

Honolulu Heard by Wireless

The atmospheric conditions at San Francisco during the month of September seem to have been very favorable.

Operator K. M. Kristensen of the Massie Wireless Station was in direct communication with Honolulu at 9:30 p. m., Sept. 26, and also with the Matson liner, Lurline, at that time 1,645 miles from the San Francisco Light-ship.

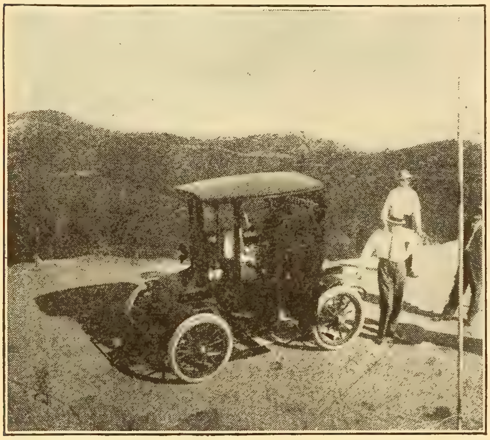
Operator Frank E. Daubenbiss of Station C. O., Capitola, California, picked up the S. S. Hilonian at 8:00 p. m., September 27, 1,145 miles out, and the S. S. Santa Rita from Kahului for San Francisco, 1,350 miles away. Also the S. S. Asia from Hongkong via Honolulu to San Francisco, 1,191 miles out. Mr. Daubenbiss' remarkable feat was accomplished with a silicon detector and a 100-foot aerial amateur set built by the owner from descriptions given in POPULAR ELECTRICITY.—F. E. DAUBENBISS.

Automobile Wireless on Mountain Top

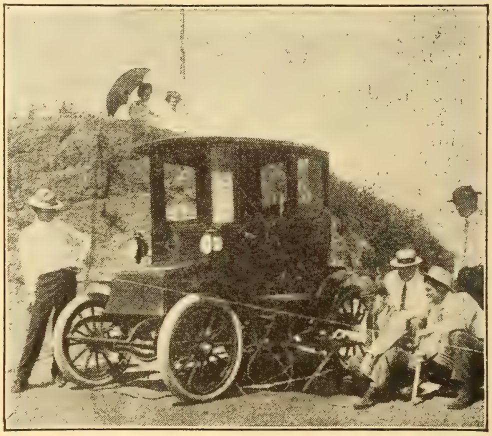
By F. C. RYAN

To be seated in an electric coupé by the side of a portable wireless set, whisked over fifteen miles of country and then up to the top of a mountain more than 2,000 feet above the sea level was my novel experience as one of the operators at the United Wireless station in the Examiner Building, Los Angeles, California. At the top a mast and aerial were set up, communication with the city established and commercial stations within a radius of 100 miles reached.

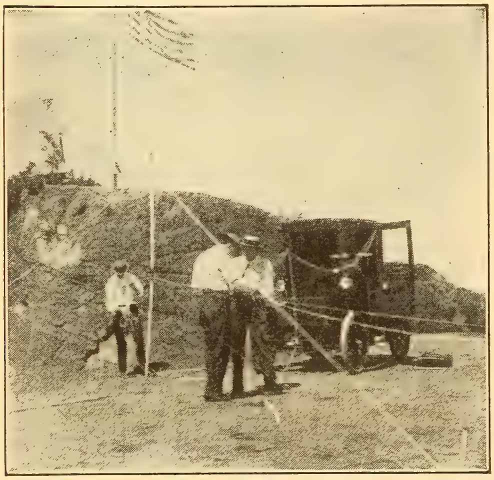
The "stunt" was done at the behest of an automobile concern of the city who were anxious to demonstrate the range and pulling capacity of one of their electric coupés—a four-passenger car intended for the use of the ladies. The demonstrator for the firm conceived the idea that it would be a good thing to take along a portable wireless plant and communicate with the city, should the mountain be successfully scaled by the electric car.



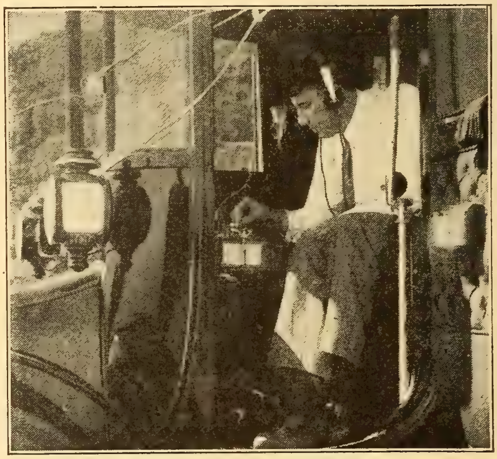
LOOKING TOWARD THE PACIFIC FROM THE TOP OF LOOKOUT MOUNTAIN



SENDING THE FIRST MESSAGE FROM THE MOUNTAIN TOP



CONNECTING THE AERIAL OF THE PORTABLE SET



INSIDE OF THE AUTOMOBILE WIRELESS STATION

The mast used was modeled after that furnished for the portable sets of the United States Signal Corps, being made up of six sections, each five feet long, of split bamboo. The aerial was composed of eight 30-foot lengths of No. 12 aluminum wire which were extended on out with rope guys. The aerial was laid out in "umbrella" form, and directly underneath and fastened to the same stakes were eight duplicate wires suspended from the mast at a point five feet above the ground forming a counterpoise which was used instead of a ground.

The portable set was made up of a six-inch Collins coil, a copper-foil jar condenser, a small helix of No. 9 copper wire and an ordinary telegraph key. The power for transmission was obtained from the storage battery of the automobile. The receiving set was of the double slide type with fixed condenser. A silicon detector with no battery was used in conjunction with 1,000-ohm head phones.

Arriving at the top of Lookout Mountain with the electric coupé which carried a load of two large men and the portable wireless plant which weighed about 150 pounds, it was found that there was a space barely 40 feet in diameter in which to lay out the aerial. The mast and aerial were erected under this disadvantage, and the necessary wires connected to the set. Immediately upon listening and getting the detector in adjustment the Navy station at Point Loma 100 miles south was heard very distinctly, sending their midday weather report to Point Arguello about 150 miles north. Then the faint response of the northern station was heard. After they had finished, the two commercial stations at Avalon, Catalina Islands, 40 miles distant were heard very clearly. Then the steamers Admiral Sampson and Governor somewhere out in the Pacific ocean were heard endeavoring to get into communication with the coast. The opportunity soon presented itself however to see what the portable would do in sending. The storage battery of the automobile was connected to the coil and the station in Los Angeles called. No sooner was the switch thrown back to the receiving side than an avalanche of interested amateurs in and around Los Angeles were busily inquiring who the new intruder into the air might be. After the amateurs had stopped the station in Los Angeles was "picked up" and a message of greeting sent to the Mayor announcing that for the first time in the history of the Pacific coast an electric automobile carrying a portable wireless plant, had successfully climbed the steep mountain grade to the top of the mountain peak. This done, the station was dismantled and the return trip made to the city without mishap.

Open Core Wireless Transformer

By A. B. Cole

We are often asked whether an open core wireless transformer is as efficient as one of the closed core type. Before answering this question it will, no doubt, be of interest to many of our readers to explain the working principles of these two types.

In the closed core type of transformer the iron core forms a complete path for the magnetic lines of force developed by the windings. When alternating current flows through the primary winding a counter electromotive force is developed, which tends to choke back the current supplied. When current is drawn from the secondary winding, this counter electromotive force is reduced to an extent depending on the quantity of current supplied by the secondary, and consequently more current flows through the primary. The counter electromotive force is directly proportional to the number of lines of force passing through the primary. When no current flows through the secondary these magnetic lines of force are large in number, but placing a load on the secondary winding reduces the number of lines and consequently the primary is allowed always to draw sufficient current from the source to generate the required amount which is being drawn out by the secondary. Carrying this a step farther, if you short circuit the secondary and take theoretically an unlimited amount of current from it you will cut down the counter electromotive force in the primary practically to zero and enough current would then flow through the primary to burn it out.

In the ordinary wireless transformer of the closed core type an auxiliary path of the lines of force is provided which prevents the primary from burning out under such conditions, by generating the necessary counter electromotive force in the primary coil.

In the operation of a wireless transformer the secondary is practically short circuited for an instant during the passage of the spark, a certain part of the electrodes being vaporized and forming a conducting path in the spark gap. The effect on the primary of this short circuit in the secondary is overcome in the open core transformer as follows:

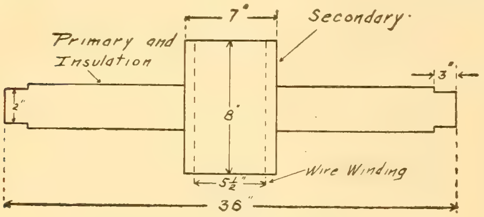
In an open core transformer there is a much greater magnetic leakage than in the closed core type, the leakage path being the air space outside the windings, starting out from one end of the core, and returning to the opposite end. For this reason no other path of magnetic leakage is needed.

The primary of an open core transformer must, however, have a much larger number of turns of wire, since only a part of the magnetic circuit is through iron, and since air presents a much higher resistance to the lines of force than iron.

In consideration of the above facts, it is our opinion that an open core transformer, properly designed and operated, is just as efficient as one of the closed core type. The open core type is the standard of the United Wireless Telegraph Company, who claim that it is as efficient as the closed core variety.

The following data will enable our readers to build an open core transformer which will operate on 100 to 125 volts alternating current, and any frequency from 60 to 133.

The core is two inches in diameter and 36 inches long, and is made of twelve pounds of No. 20 black Norway iron wire. The primary winding is 30 inches long and consists of one layer of No. 10 D. C. C. magnet wire, of which six pounds are required.

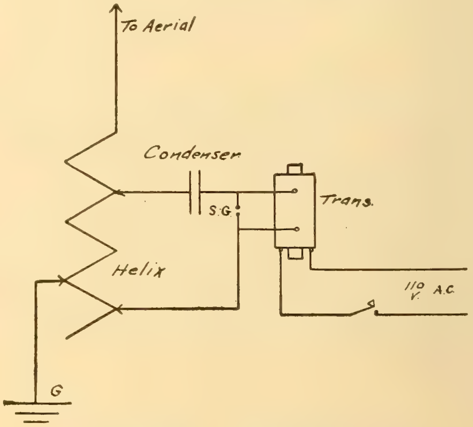


OPEN CORE TRANSFORMER

The secondary consists of one section seven inches wide, having an outside diameter of eight inches. The wire winding is 5½ inches wide, and consists of 104 layers, each of 264 turns of No. 28 D. C. C. magnet wire. About ten pounds of wire are required for the secondary. A good grade of paper 0.004 inch thick is used to insulate each layer from the next.

The primary is insulated from the core by a hard rubber or fibre tube 36 inches long, and having a wall 3-16 inch thick. The secondary is insulated from the primary by several layers of Empire cloth so as to give a thickness of the cloth of ⅛ inch. The secondary may be wound on a cardboard tube which fits outside the Empire cloth.

In winding the transformer and the reactance coil described below, great care should be taken to wind the wire on evenly. After the transformer is wound, it should be boiled in paraffine until no air bubbles rise from it. It should then be placed in a wooden case which should be filled slowly with hot paraffine or sealing compound.



CONNECTIONS OF TRANSFORMER

The primary and secondary wires should be connected to binding posts. Too much emphasis cannot be laid on the importance of having the very best insulation in the secondary.

The adjustable reactance coil consists of seven pounds of No. 12 D. C. C. magnet wire wound in six layers on an iron core eight inches long and 1½ inches in diameter. About 1½ pounds of No. 20 black Norway iron wire will be required for this core. A tap is brought out from the end of each layer, the wire leading out being securely soldered to the wire on the coil. This coil may now be placed in a wooden case, and the six taps and that from the end of the coil brought to binding posts, so that any number from one to six layers may be connected in circuit at will.

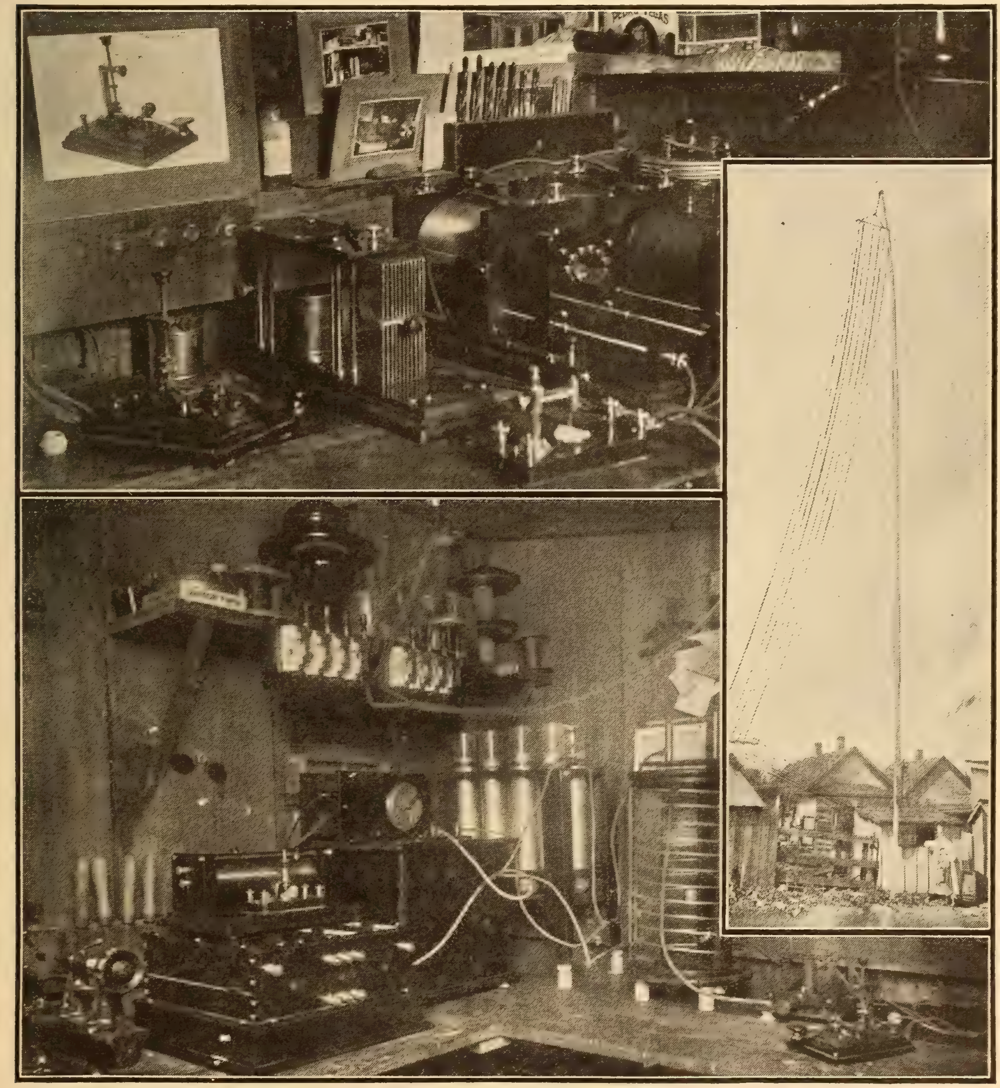
The reactance coil is always connected in series with the primary of the transformer and the line. With all layers in use the transformer may be rated at ½ K. W., and various capacities are available up to about 1½ K. W. by using more or less of layers on the reactance coil. This arrangement is of especial advantage where there is considerable interference between stations, as small power can be used for short distance working.

If so desired this transformer may be operated in series with an electrolytic interrupter on 110 to 220 volts direct current.

Amateur's One-Kilowatt Station

A more than usually complete amateur station is that of Bernadotte Anderson of Kansas City Mo., who sends us the accompanying pictures of his sending and receiving outfits and aerial, together with the following synopsis of the equipment:

Transmitting apparatus: One K. W. closed-core transformer, operating on 10,



AMATEUR'S ONE KILOWATT STATION

volts a.c., 60 cycle. Present consumption ½ K. W. High tension condenser, leyden jar type, in rack. Sending inductances, both closed and loose coupled type. Special type antenna switch. Zinc spark gap, open type. Special type key, heavy alloy contacts.

Receiving apparatus: Tuners of various types, including loose coupled, closed, etc. Several variable condensers. Silicon and carborundum detectors are given preference over other similar kinds. Receivers of 2,000 ohms.

Antenna and mast: Height of mast 75 feet. Aerial composed of eight wires leading to eight individual switches located inside of station on hard rubber baseboard. All wires being open at top and divided into a loop aerial of four wires each, permit of any number of wires being used, by cutting in and out the switches. This has proved very valuable both on transmitting and receiving, by securing a large variation of the electrostatic capacity and inductance of the aerial. Insulation is given due attention, several 75,000 volt high tension insulators being used. The bushings in the wall through which aerial wires pass are of porcelain tubings, a smaller one inserted in a larger one, thereby giving a wall about ½ inch thick. The aerial wires proper are insulated from each other on spreaders by ordinary porcelain cleats.

The method I use in protecting the aerial from lightning is by weaving a large brass bar through the eight wires and attaching a ground wire of automobile cable. After learning of a disaster which occurred in the case of one of my wireless friends, due to his failure to ground his aerial properly, the lightning playing havoc with his mast, I am very cautious in this respect.

With the transformer consuming ½ K. W., have been able to cover a transmitting distance of 65 miles, using directional radiation. As there are no commercial stations within a radius of 500 miles, except a few government experimental stations, within 100 or 200 mile radius, have not been able to give the receiving apparatus a fair test, although am able to procure very sharp and selective tuning. A good deal of the apparatus has been constructed myself, including the transmitting set, while I have replaced the shop constructed receiving equipment, with Murdock type apparatus. Hope to have a set of measuring instruments in the near future, in order that I may determine interesting calculations in connection with my experiments. Have also a wireless telephone set nearly completed, using the oscillation arc for producing continuous oscillations. On this set am using a combination of systems in use by the prominent wireless telephone men.

WIRELESS QUERIES

Answered by A. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

Condensers for Sending and Receiving; Battery for Two-Inch Coil

Questions.—(A) How many 5 by 7 inch glass plates should I use for a fixed condenser for receiving? (B) How many 5 by 7 inch glass plates should be used for making a secondary condenser for a two-inch coil? (C) Will six carbon cylinder batteries be sufficient to run the above coil? If not, how many?—R. J., Muskogee, Okla.

Answers.—(A) Six or eight will give good results for most stations.

(B) From ten to 20, depending on the speed of the interrupter and the capacity of the aerial.

(C) Yes, but eight will give better results.

Condensers for Sending Set

Questions.—(A) What size of condenser should I use across the vibrator contacts of a four-inch coil? I wish to employ glass plates either 5 by 7 or 8 by 10 inches. (B) How many quart size Leyden jars shall I make to bridge across a spark gap? (C) Would a plate condenser be better than Leyden jar? If so, give size and number of plates to use, plates to be stacked as compactly as possible.—E. L. F., Osceola, Ia.

Answers.—(A) The number of plates for this purpose would be prohibitive, owing to the thickness of the glass as compared to that of paper. For example, the table on page 163 of the June issue shows that 2,500 square inches of foil would be required with paraffined paper as the dielectric. This paper should be .002 inch thick. About 150 glass plates each 5 by 7 inches would be needed to take the place of the paper and give the same capacity. For this reason paper is nearly always used.

(B) From two to six, depending on the speed of the vibrator and the capacity of the aerial.

(C) A plate condenser will take up less space. From 20 to 40, each 8 by 10 inches, would be required, if their thickness is that of photographic plates.

Receiving Condensers; Ground Wire

Questions.—(A) Is a short aerial better than a long one for sending? (B) Give dimensions for a tin foil and paper sending condenser for a one-inch coil. (C) Give dimensions for a tin foil and paper condenser for receiving. (D) What size of wire is best for a ground wire?—A. E., Bronx, N. Y.

Answers.—(A) No, a long aerial, within limits, gives better results.

(B) Paper cannot be used as the dielectric for such a condenser, as the voltage developed by the coil will puncture it.

(C) Alternate a layer of tin foil, one of thin paper, another of foil, and another of paper, and roll up into any convenient form. Dimensions of foil, 2 by 50 inches. Dimensions of paper, 3 by 56 inches.

(D) A large wire, in the neighborhood of a No. 4, should be used for this purpose.

Voltage and Spark Gap; Noise in Telephone Receiver

Questions.—(A) What voltage is required to jump an air gap of ½ inch? (B) How can I get rid of the humming in a telephone receiver?—C. F., Alamogordo, N. Mexico.

Answers.—(A) For sinusoidal voltages, 10,000 volts will jump a gap of one-half inch between sharp needle points.

(B) If the noise is due to the nearness of light and power and other wires the induction effect may be destroyed by transposing the wires at intervals along the line.

Helix and Condenser for One-Kilowatt Transformer

Questions.—(A) How many feet of No. 0 B. & S. aluminum wire will I need for a helix to go with a one K. W. transformer? (B) How many glass plates and sheets of tin foil are required for a sending condenser? What are the sizes of plates and foil for the above transformer?—A. R., Grand Island, Neb.

Answers.—(A) About fifteen feet.

(B) On page 450 of the September, 1910, issue, there is given a full description of a plate condenser which will serve your purpose very well.

Sliding Plate Condenser

Questions.—I wish to make a variable condenser of the sliding type composed of five stationary brass plates four inches wide by five inches long and four movable ones of the same dimensions. (A) How far apart should the plates be and of what thickness? (B) Would aluminum be better than brass to use for the plates? (C) Would you advise me to make the plates larger or is the size I describe good practice?—H. J. R., Philadelphia, Pa.

Answers.—(A) They should not be over 1-16 inch apart, and may be No. 20 or No. 21 gauge, about 1-32 inch thick.

(B) One is as good as the other.

(C) The size and number you describe are all right, but it should be remembered that the distance between them must be small.

Variable Condenser

Questions.—(A) Would the oil-immersed condenser described on page 452 in the September, 1910, issue be just as efficient if covered with paraffin instead of oil? (B) Would a variable condenser for receiving set consisting of stationary and movable aluminum plates be just as efficient if the plates were separated by sheets of thin mica instead of an air gap?—C. R. H., Des Moines, Iowa.

Answers.—(A) No, because it would be extremely difficult to obtain the required insulation between plates, on account of the formation of air bubbles, and because if the oil gives way the point of the rupture is immediately covered.

(B) Yes, more so, on account of the higher dielectric capacity of the mica.

Purpose of a Spark Coil Condenser

Question.—Of what use is a condenser in connection with a spark coil?—A. C. K. Lytton, Iowa.

Answer.—At the "break" of the circuit in an induction coil a rush of current takes place which produces a bright spark at the contact breaker and also prolongs the period of demagnetization of the core. This is a bad effect since the power of the coil depends in part upon the rapidity of the magnetization and demagnetization of the core. To reduce the effect of this "extra" current a condenser is connected across the contact breaker and the rush of current is stored until the circuit is again made, when it to a certain extent aids the battery current. The condenser, therefore, reduces the destructive sparking, shortens the period of demagnetization of the core and increases in length, thickness and brilliancy the spark from the secondary coil.

QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

Square to Circular Mils; Volts Lost

Questions.—(A) How can I change square mils to circular mils? (B) In the formula, $V=\frac{IxLx10.8}{C.\ M.}$ for determining the volts lost in a certain wire with a given current flowing what is the 10.8?—B. L., Chicago, Ill.

Answers.—(A) A circular mil is .7854 of a square mil, so divide the number of square mils by .7854 to express the same in circular mils.

(B) It is the resistance of one foot of commercial copper wire one circular mil in section and at 75° F.

Which Plates are Positive?

Question.—I have seven plates out of a storage battery. Three are red and four are grey. Which are positive plates?—C. B., Sparks, Nevada.

Answer.—The number of negative plates always exceeds the positive by one in a storage battery, the object being to use the two sides of every positive. When a battery is first started on charge the negatives are a yellowish grey and the positives dark brown.

Battery Solution; Gas Lighting Coil

Questions.—(A) What is the solution in a Leclanché battery (B) How much and what size wire should I use in winding a coil for gas lighting purposes? (C) How much No. 34 copper wire will have a resistance of one ohm? No. 35? No. 36?—C. K., San Angelo, Texas.

Answers.—(A) Make a strong solution of ammonium chloride (sal ammoniac) by stirring this powder into water until the water will dissolve no more. Place this solution in the outer jar.

(B) On a soft iron wire core $\frac{3}{4}$ inch in diameter and eight inches long wind five layers of No. 18 wire and connect in series with key, battery, and gas tips.

(C) No. 34, 3.839 feet; No. 35, 3.045 feet; No. 36, 2.414. By reference to a standard wiring table a column will be found in which "Feet per Ohm" for different sizes of wire is given. Booklets containing such a table and other information can be had by writing to any wire manufacturer or dealer.

Protection Against Lightning

Question.—Where can I obtain information regarding the installation of lightning conductors to protect buildings, chimneys, etc.—D. W. G., Punxsutawney, Pa.

Answer.—Write to the National Board of Fire Underwriters, 93 Water St., Boston, Mass., for their booklet, "Protection Against Lightning," which will be mailed to anyone interested.

Depolarizer; Transformer Losses

Questions.—(A) What is the object of the powdered manganese in a dry cell? (B) What relation do the losses in a transformer bear to the frequency?—H. G. W., Chicago.

Answers.—(A) The manganese acts as a depolarizer.

(B) Reference to any standard work on transformers will show from the equations for hysteresis and eddy current losses that these losses are directly proportional to the frequency which is only one of the factors of the equation, however.

Electromagnetic Effect

Question.—Explain the effect upon a fixed iron bar core when current flows through a coil wound around it.—G. M. L., Longmont, Colo.

Answer.—It becomes more or less strongly magnetized according to the number of turns in the coil and to the number of amperes sent through the coil. One end becomes a north pole and the other a south pole determined by the direction of the coil winding and current. A point will be reached finally where a stronger current will fail to add magnetism, and this point is called the saturation point.

Defenses to Patent Infringement

By OBED C. BILLMAN, LL. B., M. P. L.

STATUTORY DEFENSES; DEFENSES OTHER THAN STATUTORY; USUAL DEFENSES

Statutory Defenses.—The statute specifies certain special matters which a defendant in an action for infringement may prove in his defense.

The First of These Special Matters is that the patentee has with fraudulent intent filed a description and specification containing less or more than the invention or discovery warrants.

The Second Special Matter Pleadable is that the patentee has surreptitiously and unjustly obtained the patent for that which was in fact invented by another.

The Third Defense specified by the statute is that the invention had been patented or described in some printed publication prior to the supposed invention or discovery of the patentee.

The Fourth Defense open to the defendant is that the plaintiff was not the original or first inventor of any material or substantial part of the thing patented.

The Fifth Defense allowed by the statute is that the invention had been in public use or on sale in the United States for more than two years before the application of the plaintiff for a patent, or that it had been abandoned to the public.

Defense Other Than Statutory.—*In General.*—The statutory defenses above enumerated are not the only ones which may be made to an action for infringement. A patent may be open to attack in one or more of the numerous elements that combine to constitute its validity, and any plea that attacks the validity of the patent constitutes, if established, a defense to a charge of infringement.

Usual Defenses.—The more usual defenses of this class are here enumerated, and their force and effect are briefly set forth.

A License granted by the patentee or owner of the patent is a perfect defense to an action for infringement or to a bill for an injunction. The existence of the license must be determined by the court, and it must be strictly construed and limited to its exact terms. Where the defendant sets up a license and offers to pay into court the usual license fee, or claims breach of the contract of license, the court will refuse an injunction. Having been compelled to pay damages for infringement does not constitute a license to the defendant or to any one else to continue the infringement. Purchasing an interest in the patent carries a right to use a machine made thereunder, and such right includes an extended term. The defense of license is not inconsistent with the defense of invalidity of the patent.

The Infringer May Set Up a Release from All Liability for infringement, executed upon sufficient consideration of the patentee.

Other Matters.—But the infringer of a patent cannot set up that he did not intentionally infringe, nor that he made no profits by the infringement, nor that the patent is about to expire or is of little value, nor that the patentee refused to furnish the device when requested, nor that he infringed as a public employee and for the public benefit, nor that the patentees were not in fact joint inventors, nor can the patentee set up in a court of equity a purely technical defense unless able to support it by ample and satisfactory proof.

That the Patent is Void for failure to observe prerequisites to the issuance thereof is a good defense.

Absence of Patentability is a very broad ground of defense, and should usually be narrowed down to more specific terms. When clearly apparent, the court may dismiss the suit on this account although not set up as a defense. And the existence of the original patent cannot be set up as a defense to infringement of a patented improvement thereon.

The Want of Utility in the invention may not generally be set up by an infringer. The fact of use is sufficient to stop the user from making such plea.

Absence in the Record of Evidence of the Patentee's Oath is not a defense, since the oath need not be in writing and may have been properly administered.

Article not Marked.—The defendant in an infringement suit cannot plead the fact that either the article infringed or the article infringing was not marked "patented" as required by section 4900 of the Revised Statutes.

Use of the Invention Before Grant of the Patent is no excuse for infringement after such grant.

That the Patentee has Created or is Attempting to Create a Monopoly in the patented article or business, or is a member of an illegal trust, or resorts to infringement suits. or compromises in order to secure a practical monopoly, is no defense to infringement.

Estoppel as Defense.—Either the complainant or defendant may be met at some stage of the proceedings by the assertion of an estoppel. When set up by the defendant it is usually in the nature of a plea in avoidance, and sets forth some act by which the complainant has deprived himself of the right to object to the act claimed to constitute infringement. Thus license to use or sell the patented article will estop the licensor to deny the licensee's right. The complainant is furthermore estopped by his admission that another than himself has the power to grant a license. In an action against a license under another patent, the complainant is not estopped by a judgment declaring his patent to be an infringement, when the license was granted before the judgment was rendered. Where, by agreement, a final decree has been entered directing a perpetual injunction, and such injunction has issued, the plaintiff does not, by subsequently granting a license to the party enjoined, deprive himself of the right to demand his commitment for disobedience to the injunction. A complainant corporation is not estopped to sue an infringing corporation by the fact that both corporations are subsequently absorbed by a third corporation. When the defendant has not acted upon the notice of infringement, the complainant is not estopped by the notice to claim for prior infringements. A patentee is not estopped by his representations as to the identity of the foreign and United States patents if made under a misapprehension as to the facts. But a correction limiting the duration of the patent, although made under mistake, will estop the patentee and his co-owners when cognizant of his actions in the matter. A complainant is not estopped by the discontinuance of one action from bringing a second.

Silence, Unless Misleading, Works no Estoppel; hence an inventor is not estopped by standing by and silently hearing an infringing invention described.

Collateral Attack.—It is a general rule that the validity or regularity of a patent cannot be attacked collaterally in an action for infringement. The proceeding preliminary to issuance and the signature of the proper officers are presumed to be regular and must be respected until impeached or set aside in a direct proceeding instituted for the purpose.

NEW BOOKS

MOTOR TROUBLES. By E. B. Raymond. New York: McGraw-Hill Book Company. 1909. 197 pages with 98 diagrams and illustrations. Price $1.50.

A book treating of the specific troubles to which motors are subject; how to trace and remedy them.

FLYING MACHINES: CONSTRUCTION AND OPERATION. By W. J Jackman, M. E., and Thos. H. Russell, A. M., M. E., with an introductory chapter by Octave Chanute, C. E., Chicago: Chas. C. Thompson Company (Not Inc.). 1910. 221 pages and 94 illustrations. Price, cloth, $1.00; flexible leather, $1.50.

This book is intended to give the reader interested in aerial navigation, practical instruction in the building and operation of flying machines.

PRACTICAL HANDBOOK FOR MILLWRIGHTS. By Calvin F. Swingle, M. E., Chicago: Frederick J. Drake & Co. 1910. 411 pages with 226 illustrations. Price $2.00.

A work embodying useful information on how to plan and build mills and install mill machinery from the foundation up.

ELECTRICITY EXPERIMENTALLY AND PRACTICALLY APPLIED. By Sidney Whitmore Ashe, B. S., E. E. New York: D. Van Nostrand Co 1910. 349 pages with 422 illustrations. Price $2.00.

A book for the beginner and for the practical man, containing principles, experiments, practical applications and problems.

WIRELESS TELEGRAPH CONSTRUCTION FOR AMATEURS. By Alfred P. Morgan. New York: D. Van Nostrand Company. 1910. 188 pages with 147 illustrations. Price $1.50.

An excellent book for those who desire practical information on the building and operation of wireless equipments which are more than toys yet not so expensive as commercial equipments.

ON POLYPHASE SUBJECTS

Wellman's Achievement Many of the newspapers that had no hand in the fitting out of Walter Wellman's dirigible balloon expedition poked all sorts of fun at the daring aviator and made humorous "mind bets" that he never would start—humorous in the light of later developments. Nevertheless Wellman did start and did not stop until he had made a record eclipsing all previous balloon feats. It is now a matter of history that he started out with his intrepid crew at eight o'clock on the morning of October 15 and was rescued at sea by the steamer Trent after being in the air 72 hours. The previous record, made by the renowned Count Zeppelin, was a continuous flight of 37 hours' duration. The distance covered by Wellman is variously estimated at from 800 to 1,200 miles. Zeppelin's record was 850 miles.

During the first part of the flight the world was kept fairly well informed of the movements of the dirigible through the wireless messages sent out from it. From the time it began to be blown southward, off Nantucket, nothing was heard, for the adventurers were not willing to waste their power which might be sorely needed later.

The details of construction and the method of operation of this wonderful aircraft were fully explained in last month's issue of Popular Electricity. This description, which was the first magazine article on the subject, was fortunately made available at the very time the trip was in progress. The life-boat which held Operator Irwin and the unique arrangement of which was fully explained in the article worked exactly as it was intended to, and the entire crew was saved, including the now famous cat.

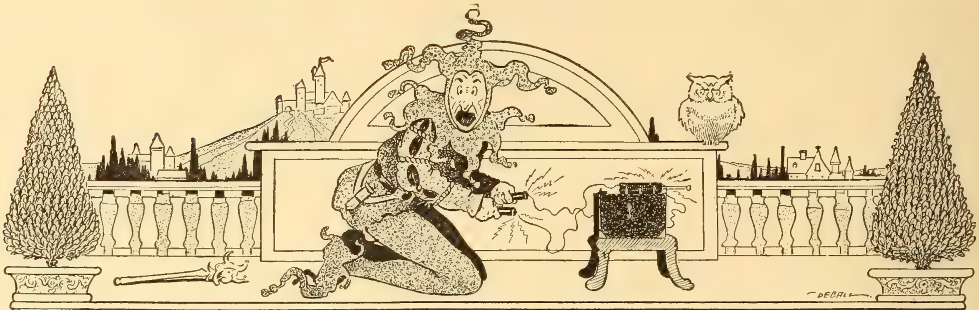
The expedition shows one thing: namely, that the most carefully constructed dirigible now possible is in reality at the mercy of the winds. If the winds were favorable all the way it is quite possible that the America or another craft of like design could fly across the Atlantic. But with present knowledge of dirigible ballooning the "if" is decidedly the most important factor.

Lectures on Illuminating Engineering Johns Hopkins University offers for the academic year 1910-1911 a course of 36 lectures on the science and art of illuminating engineering. This course owes its origin to the following considerations:

The Illuminating Engineering Society, recognizing the fact that there is an increasing demand for trained illuminating engineers and that the present facilities available for the specialized instruction required are inadequate, determined, through an act of the Council of the Society, to encourage the establishment of a course of lectures on the subject of illuminating engineering. This course should have three objects: (1) to indicate the proper co-ordination of those arts and sciences which constitute illuminating engineering; (2) to furnish a condensed outline of study suitable for elaboration into an undergraduate course for introduction into the curricula of undergraduate technical schools; and (3) to give practicing engineers an opportunity to obtain a conception of the science of illuminating engineering as a whole.

The course covers nineteen subjects, with laboratory work in connection. The lectures represent the best talent in the country, including such men as Charles P. Steinmetz, J. W. Lieb, Jr., L. B. Marks, Louis Bell, Edward B. Rosa, Clayton H. Sharp, Edward P. Hyde, Van Rensselaer Lansingh and John B. Watson.

Georgia Section of the N. E. L. A. A new geographic section of the National Electric Light Association has been formed, known as the Georgia Section. The officers are: President, John S. Bleecker, Columbus; vice-president, W. R. Collier, Atlanta; executive committee, J. J. Cagney, Macon, R. P. Mayo, Augusta, Burdett Loomis, Jr., Waycross; secretary-treasurer, H. M. Corse, Columbus.



SHORT CIRCUITS

One day a Jew who kept a pawnshop had to leave it in charge of his son. On returning he asked how business had been during the day.

"Yes, fader, an' business vas very goot to-day."

"Vell, den, an' vatt did you sell, Isaac?

"Nottings, but der man vat bought der diamonds yesterday came in and pawn dem dis mornin."

"Vell, and didn't ye sell him nottings else?" asked the elder.

"No, fader, he look too depressed to vant anyting's else."

"Vell, if he looked depressed, why fer didn't ye sell him a revolver?"

* * *

The Imperial Barber was talkatively **trimming the** beard of King Archelaus.

"How shall I cut it, your Majesty?"

"In silence," replied the King.

* * *

"Sure it's an Irishman that's the greatest inventor o' the age an' a particular friend o' mine," blurted out Mike, after a fifth "high one."

"And who is this great inventor you know?" taunted his companion.

"Pat. Pending is me friend's name. Yez must of heard o' him afore this."

* * *

"I tell you I must have some money!" roared the King of Maritana, who was in sore financial straits. "Somebody will have to cough up."

"Alas!" sighed the guardian of the treasury, who was formerly the Court jester, "all our coffers are empty."

* * *

The victim of the dentist held up his hand. "Doctor,' said he, "before you put the lid on my conversation, will you answer another question?"

"Yes," said the dentist, selecting a square piece of rubber and snipping it with his scissors.

"Do people chew more on one side of the mouth than the other?"

"Certainly," said the dentist, picking up the clamps.

"How interesting. Which side?"

"The inside," replied the dentist, as he slipped the rubber dam over the verbal one that issued from the patient's lips.

* * *

Gertrude to Mabel (as she bumps the bumps at the State Fair)—"What's your favorite sport?"

Mabel to Gertrude (as she picks up her hat)—"Billie."

* * *

"What're ye comin' home with your milk pail empty for?" demanded the farmer. "Didn't the old cow give anything?"

"Yep," replied the chore boy, "nine quarts and one kick!"

This is the message the telegraph messenger handed to the young husband: "Come down as soon as you can. I am dying—Kate." Eight hours after, he arrived at the summer hotel, to be met on the piazza by Kate herself. "Why, what did you mean by sending me such a message?" he asked. "Oh," she murmured, "I wanted to say that I was dying to see you, but my ten words ran out and I had to stop."

* * *

"Say, Boss," says the tramp, "will ye give me fifteen cents for a bed?"

"Sure, bring it around, and if it's worth fifteen cents, I'll buy it."

* * *

Mamma—Johnny, what is the baby yelling about?

Johnny—Nothin'. I jest took his milk and showed him how to drink it.

* * *

"Mike, how would yez like to live to be a hundred years av age?"

"I don't want to, Pat. I never seen a man that old who could put up any kind av a foight."

* * *

A Worcester County farmer was sawing wood, when it occurred to him that he ought to have the help of one or more of his five boys. Lifting up his voice, he called, but not a boy appeared.

At dinner, of course, they all appeared, and it was not necessary to call them.

"Where were you all about two hours ago, when I wanted you and shouted for you?"

"I was in the shop, settin' the saw," said one.

"And I was in the barn settin' a hen," said the second.

"I was in gran'ma's room, settin' the clock," said the third.

"I was in the garret, settin' the trap," said the fourth.

"You are a remarkable set!" remarked the farmer. "And where were you?" he continued, turning to the youngest.

"I was on the doorstep, settin' still."

* * *

Reverend Gentleman:—Do you know, my friend, that half the cases of cancer are caused by people smoking those foul, dirty, short, black clay pipes?

Son of Toil—And do you know, Guv'nor, that 'alf of the black eyes are caused by folks not mindin' their own business?

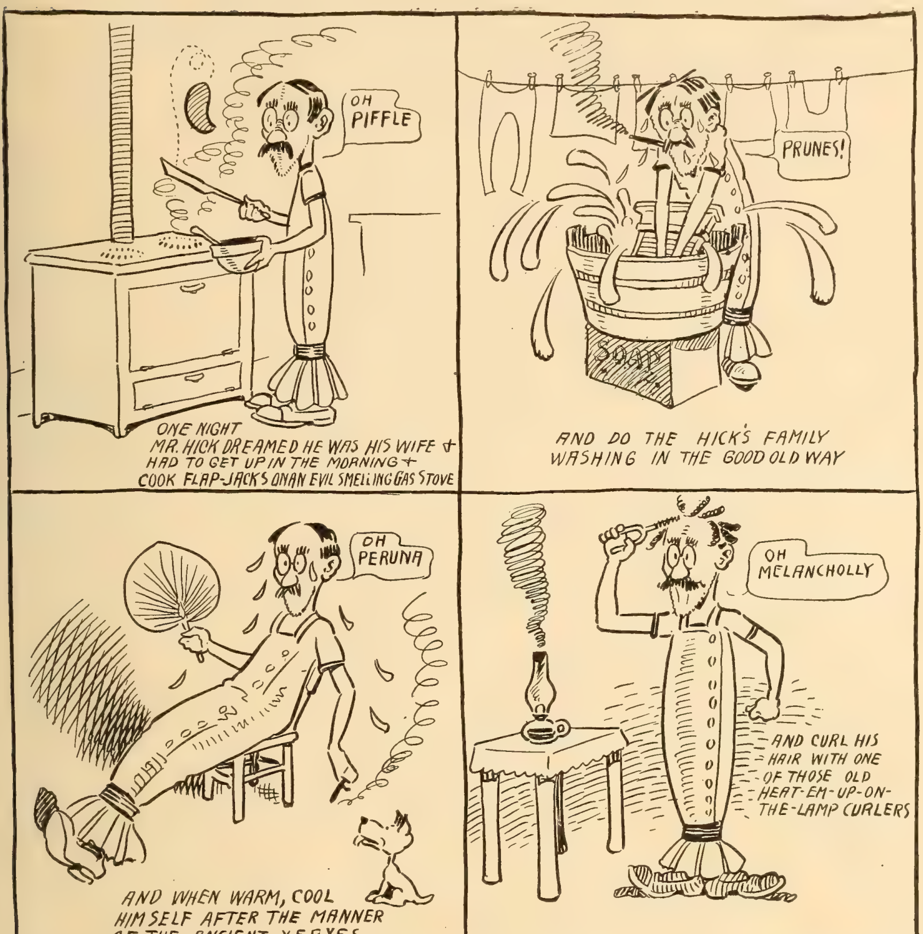
* * *

The late Justice Brewer was with a party of New York friends on a fishing trip in the Adirondacks, and around the camp fire one evening the talk naturally ran on big fish. When it came his turn the jurist began, uncertain as to how he was going to come out:

"We were fishing one time on the Grand Banks for—er—for——"

"Whales," somebody suggested.

"No," said the Justice, "we were baiting with whales."


OH PIFFLE
ONE NIGHT MR. HICK DREAMED HE WAS HIS WIFE & HAD TO GET UP IN THE MORNING & COOK FLAP-JACKS ON AN EVIL SMELLING GAS STOVE
PRUNES!
SOAP
AND DO THE HICK'S FAMILY WASHING IN THE GOOD OLD WAY
OH PERUNA
AND WHEN WARM, COOL HIMSELF AFTER THE MANNER OF THE ANCIENT XERXES
OH MELANCHOLLY
AND CURL HIS HAIR WITH ONE OF THOSE OLD HEAT-EM-UP-ON-THE-LAMP CURLERS
MRS. HICK
!?
HURRAY! I AINT NO WIFE
THEN MR. HICK AWOKE AND DISCOVERED IT WAS ONLY A BUM NIGHT-MARE
NEXT MORNING—
MRS. HICK
HELLO, IS THIS THE ELECTRIC LIGHT CO — WELL THIS IS HICK OF 7042 HICK ST. I WANT MY HOUSE WIRED AND I WANT AN ELECTRIC STOVE AND AN ELECTRIC WASHING MACHINE & A 14 INCH FAN & SEVERAL OTHER LITTLE THINGS. PLEASE ATTEND TO IT AT ONCE
DE BALL

COMMON ELECTRICAL TERMS DEFINED

In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.

Center of Distribution.—The point or panel to which a main feeder is connected and from which branch circuits through fuses and switches are taken off.

Central Station.—The plant containing engines, dynamos and other apparatus necessary to supply a certain territory with electricity.

Characteristic Curve.—The indicator diagram of a steam engine may be termed its characteristic curve. In a dynamo or a motor it is a curve showing the relation between the speed and voltage or between any two other factors as the current and voltage.

The curve is made by laying off a horizontal line to represent one set of units, as amperes, and a vertical line to represent the other set, as volts. Then for a certain point on the vertical line the amperes will by test have a certain value on the horizontal line which determines one point. A curve traced through several such points is a characteristic curve.

Characteristic, External.—Applied to the curve representing the relation between the volts at the terminals of a dynamo and the current flowing in the external circuit.

Characteristic, Internal.—A curve showing the relation between the volts and amperes in the shunt coil of a dynamo.

Charge.—Used with several meanings in its electrical sense (1) The quantity of electricity present on the surface of a body or conductor. (2) Applied to the electrostatic charge given a condenser. (3) Signifying the recharging of a storage battery.

Charge, Bound.—A charge of electricity held upon the surface of a body by the presence of a neighboring charge of the opposite kind.

Charge, Free.—A charge of electricity carried upon the surface of an insulated body in such a condition that it will pass to earth if the body is connected to ground.

Charge, Residual —After a Leyden jar has been discharged in the usual way and left standing for a few minutes, a second discharge of less amount can be obtained from it. The second discharge is termed residual, and according to theory is explained as being derived from the dielectric or glass which, while holding the charge is under tension or a distortion of its molecules.

Chatterton's Compound.—A cement used in splicing telegraph cables and fastening together sheets of gutta percha. It consists by weight of Stockholm tar, one part; gutta percha, three parts; resin, one part.

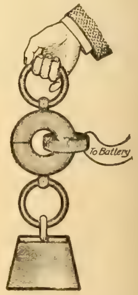
Chemical Electric Meter.—A meter consisting of an electrolyte containing two electrodes. When current is passed through the meter, one electrode loses in weight and the other gains by deposit, as in the process of electroplating. The electrodes are weighed at intervals, the one checking the other, the current that has passed being proportional to the loss in weight of one plate or to the gain in weight in the other. The Edison chemical meter is a notable example of this type.

Chimes, Electric.—A device consisting of two suspended bells having a clapper or butten hung between them by a silk thread. One bell is connected to one of the conductors of a static machine while the other bell is insulated therefrom and connected to ground or to the other pole of the machine. When the machine is operated the clapper is attracted to one of the bells where it is loaded with a like charge of electricity, then repelled and attracted to the other bell where similar action takes place, the bells continuing to ring as long as the machine is operated.

Choking Coil.—A coil of insulated wire enclosing a laminated iron core. A current passed through such a coil must use some of its energy to build up a magnetic field in the iron. This results in a choking effect on the current, hence the name. Such coils with movable cores are used in theaters and in other places where the lamps must be dimmed for lighting effects. Called also a kicking coil or a reactance coil.

Chronograph.—A device for measuring a period of time electrically. A smoked glass cylinder revolves at a uniform speed while a fine point attached to a stylus and electromagnet armature, makes a line upon its surface. A measurement of the space between two disturbances of the electric circuit of the magnet determines the time elapsing between the two interruptions of the circuit.

Circle, Magic.—A circle of round iron cut across so as to form two half circles. If a coil of wire be placed on the circle and the faces brought together, a current passed through the coil will cause the two halves to be attracted so strongly as to require considerable force to separate them. The device is used in schools and colleges to demonstrate electromagnetic attraction. (See cut)



Circuit.—A path by means of which an electric current may pass from a given point over a conductor and back to its starting point.

Circuit, Branch.—See Branch Circuit.

Circuit-Breaker.—A term generally applied to a protective apparatus which may be set to automatically open a circuit in case of the flow of a dangerously heavy current.

Circuit, Derived.—A circuit connected in parallel to two points of another circuit. A shunt circuit.

Circuit, External.—That part of a circuit which is outside of the source of current supply.

Circuit, Grounded.—A circuit in which the earth forms part of the path through which the current passes. Used on single wire telephone and telegraph lines, and on most trolley lines, the negative side of the generator being grounded.

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To Prove That You Can Artistically Color and Finish Any Kind of Wood About the Home

YOU can produce any desired shade and effect. The expense is slight—the work easy and simple. First apply Johnson's Wood Dye—made in 14 shades as listed below. Over the Dye lightly apply Johnson's Prepared Wax—and you have a beautiful, rich, subdued finish that will not mar or show scratches.

Johnson's Wood Dye must not be confused with colored varnishes or stains, which merely coat the surface of the wood hiding the natural grain beauty. Johnson's Wood Dye is not a mere stain—not merely a surface dressing—it is a deep-seated dye which goes to the very heart of the wood and stays there, fixing a rich and permanent color.

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is made in fourteen attractive shades, as follows:

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No. 125 Mission Oak
No. 140 Manilla Oak
No. 110 Bog Oak
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No. 129 Dark Mahogany
No. 130 Weathered Oak
No. 131 Brown Weathered Oak
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No. 121 Moss Green
No. 122 Forest Green
No. 172 Flemish Oak
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Pints, 50 cents each

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dries quickly over Dye or any other finish so that it may be brought to a beautiful, dull, artistic finish. It should be used for all woodwork, floors and furniture including pianos and is just the preparation for Mission furniture.

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is not a common varnish—but a thin, elastic spirit preparation superior to shellac or ordinary varnish, and is to be used over Wood Dye where a higher gloss than a wax finish is desired, drying hard in half an hour. Best preparation for linoleum and oilcloth, bringing out the pattern as glossy as new. Gallons $2.50—smaller sizes down to half pints.

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"The Wood Finishing Authorities"
Racine, Wisconsin

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Please send me free samples of Wood Dye, Shade No.................... Prepared Wax and Under-Lac—also Booklet. If samples are found satisfactory will ask my dealer to supply me.

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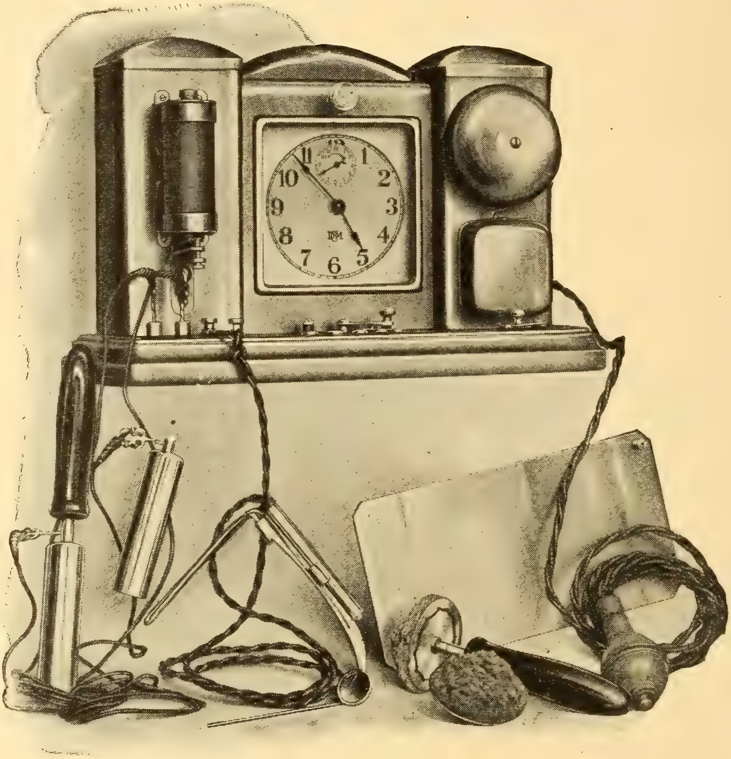
Darche Utility Household Electric Clock and Medical Battery

(Patented)

Electricity and Health



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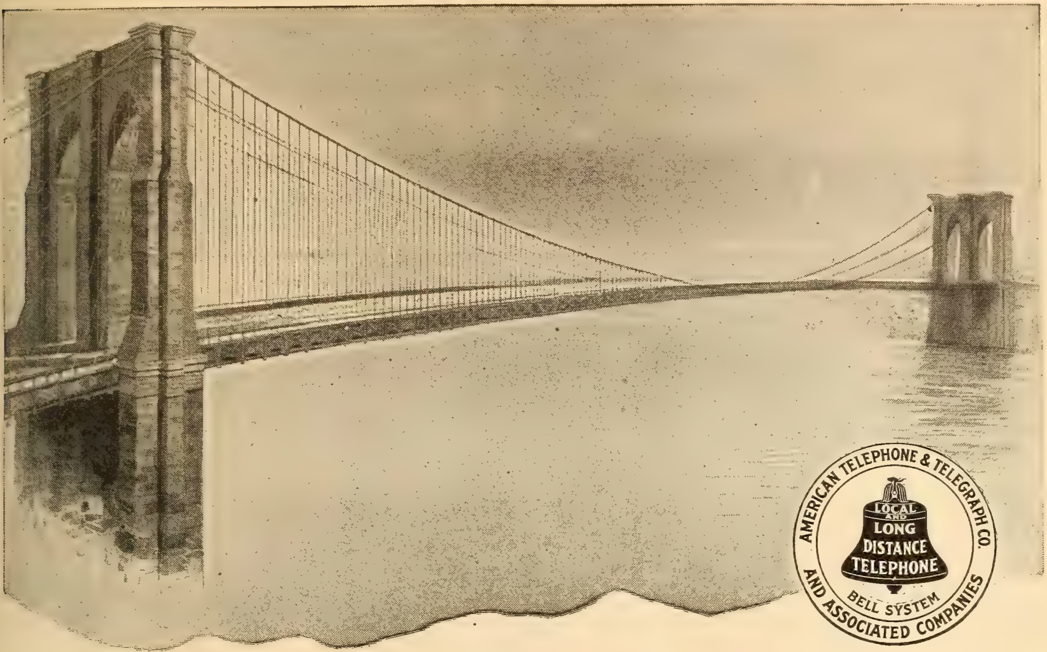
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SAVAGES built rude bridges so that they might communicate with their neighbors. These have been replaced by triumphs of modern engineering.

Primitive methods of transmitting speech have been succeeded by Bell telephone service, which enables twenty-five million people to bridge the distances that separate them, and speak to each other as readily as if they stood face to face.

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One Policy ***One System*** ***Universal Service***

The Honest Light

In one way most electric lamps are dishonest in that they consume three times as much current as is necessary. They were good—in their day but—time has passed and improvements have been made so that lamps haven't the same relative value they once had.

Before the Mazda lamp was perfected the carbon lamp was considered efficient, now however, the

Mazda Lamp

gives two and a-half times as much light and consumes no more current.

To operate a carbon lamp is really being dishonest to yourself. You are not getting what you might for the price you pay. Not only does the Mazda lamp give an honest quantity but it also gives an honest daylight quality of light.

Ask any of the member companies the why of these facts.

National Electric Lamp Association

CLEVELAND

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National Electric Lamp Association

CLEVELAND

Call upon any of them for your lamp supplies.

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THE BRILLIANT ELECTRIC CO., Cleveland, O.
BRYAN-MARSH COMPANY, Central Falls, R. I.—Chicago, Ill.
THE BUCKEYE ELECTRIC CO. Cleveland, O.
THE BUCKEYE ELECTRIC LAMP CO., City of Mexico
THE CLEVELAND MINIA. LAMP CO., Cleveland, O.
THE COLONIAL ELECTRIC CO., Warren, O.
THE COLUMBIA INC. LAMP CO. St. Louis, Mo.
ECONOMICAL ELECTRIC LAMP CO., New York City
THE FOSTORIA INC. LAMP CO., Fostoria, O.
THE GENERAL INC. LAMP CO., Cleveland, O.
THE JAEGER MINIA. LAMP MFG. CO., New York City
THE MONARCH INC. LAMP CO., Chicago, Ill.
THE WARREN ELECTRIC & SPECIALTY CO., Warren, O.
NEW YORK & OHIO COMPANY, Warren, O.
THE SHELBY ELECTRIC CO., Shelby, O.
THE STANDARD ELECTRICAL MFG. CO., Warren, O.
THE STERLING ELECTRICAL MFG. CO., Warren, O.
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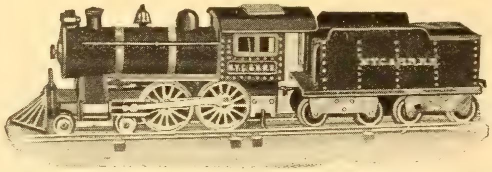
Give him toys that are more than temporarily entertaining. Electrical toys, while surpassingly fascinating merely as toys, are also really practical in developing ingenuity and mechanical knowledge.

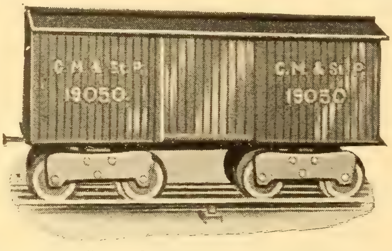
We carry a large and most complete line of electrical mechanical toys of all kinds, embracing engines, coaches, freight cars, street cars, stations, track, switches, signals, and like equipment; gunboats, sub-marines, launches, toy shop machines, etc., etc. Descriptions and prices on request.



No. 6—Express Locomotive; sheet steel construction; working parts and trimmings highly nickel-plated; length of engine, 13½ in.; height above rails, 5½ in.; the tender measures 9x4x3½ in.; equipped with a four wheel pilot truck, so constructed as to assure perfect action and flexibility; also an electric headlight, with a miniature incandescent bulb; weight, 7 lbs; without track. Each............................**$11.25**

No. 18—Pullman; sheet steel construction; built with vestibules on each end; imitation leaded glass windows, two four-wheeled trucks; interior fitted with seats; beautifully decorated in colors; length, 16 in.; height from tracks, 6½ in.; weight, 2½ lbs. Each **$4.15**

This is the most perfect miniature Pullman Car ever designed as a toy. It has every appearance of the regular Pullman Passenger car and is of substantial construction.



No. 14—Box Car; sheet steel construction; sliding doors and roof; equipped with hand brakes and couplers; two four-wheeled nickel-plated flexible trucks; length, 11 in.; height, 4 in.; weight, 1 lb. Each.......................................**$2.20**

These Box Cars are neatly decorated and lettered, and represent the freight cars now in use by modern railways. No train equipment is complete without a few of these Box Cars.

No. 8—Pay-As-You-Enter Car; sheet steel construction; handsomely decorated in three colors, with appropriate lettering in gold; equipped with two four-wheeled trucks and automatic reverser; furnished with eight curved sections of tracks and ten straight sections, making 23 feet of track in all; length, 18 in.; height, 6 in. above rails; complete as described, with an attractively decorative fender; weight, 8½ lbs. Each **$11.65**

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A. S. Elliott, Bandon, Ore., says: "My Course in Electrical Engineering has enabled me to fill responsible positions with several large milling companies in British Columbia, in Oregon, and with the United States Reclamation Service. Now I am in charge of the business of the Bandon Light and Power Co. Without the training given me by the I. C. S. I would not have been able to hold successfully any of these positions. The Course has been worth to me approximately $3,000 in increased earnings within the last 5 years."

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¶ Advertisements in this section of Popular Electricity will cost 5 cents per word with 5% off for 3 times, 10% off for 6 times, 15% off for 9 times and 20% off for 12 times, cash with order.

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$25 TO $40 A WEEK AT HOME OR TRAVELing. If you are making less than $25 to $40 a week, sit right down and write to the American Woolen Mills Co. for the most amazing money-making proposition of the age. This concern is the largest mail-order tailoring establishment in America, with immense capital and resources. They make the finest made-to-measure suits at prices that defy competition. Suits $7.50 and up. Pants $2.25 and up. All their vast business is done through agents. They start any ambitious man in the tailoring business, furnishing everything required, at their own expense. Men without any previous experience can make $25 to $40 a week, right from the start. Many of their salesmen make as high as $200 a week. The American Woolen Mills Co. produces its own cloth. This is the secret of the low prices its agents are able to offer on finest made-to-measure suits. With its own great tailoring shops, skilled tailors and finishers, it gives more style, better quality, greater value than any similar concern in existence. Best of all, it supplies its agents with handsome suits, at cost, and turns over to them all inquiries received from their territory. If any of our readers are looking for easy work, big pay and independence, we advise them to write to the American Woolen Mills Co., Dept. 496, **Chicago, Ill.**, at once, for their wonderful proposition.

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STUDY ELECTRICITY AT HOME—COMplete electrical course at home, containing 30-page detail book, 220-page text-book, 200 experiments and over 100 pieces of apparatus. Price, complete, only $5.60. Catalogue "P. E. S." explains this and other remarkable offers. Thomas M. St. John, 848 Ninth Ave., New York.

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$100 MONTHLY AND EXPENSES TO TRUSTworthy men and women to travel and distribute samples: big manufacturer. Steady work. S. Scheffer, Treas., MJ 174. Chicago.

START PROFITABLE MAIL ORDER BUSIness of your own, home evenings; money comes fast; easy work, small investment; booklet 10c.; particulars FREE. Advertising Company, P. O. Box 1615, New York.

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WE START YOU IN A PERMANENT BUSIness with us and furnish everything. We have new easy selling plans and seasonable leaders in the Mail Order line to keep our factories busy. No canvassing. Small capital. You pay us out of the business. Large profits. Spare time only required. Personal assistance. Write today for plans, positive proof and sworn statements. J. M. Pease Mfg. Co., 1185 Pease Bldg., Buffalo, N. Y.

MAKE MIRRORS AT HOME. BIG PROFITS with little outlay. One 18x36 in. mirror, costs $2.00 to $5.00. You can silver a glass this size for 20c. Send $1.00 in stamps or money order and we will send you EXPLICIT DIRECTIONS how to do it; also how to emboss, grind, foil, gold leaf, frost chip, and make imitation stained glass. How to transfer photos on glass, bore holes in glass and cut skylights. George L. Patterson & Co., Dept. 4, Brooksville, Ky.

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FREE—10 RARE FOREIGN STAMPS. Postage 4 cents. 500 mixed, 20 cents. Wm. Barrows, Dept. A, Box. 12, Hartford, Conn.

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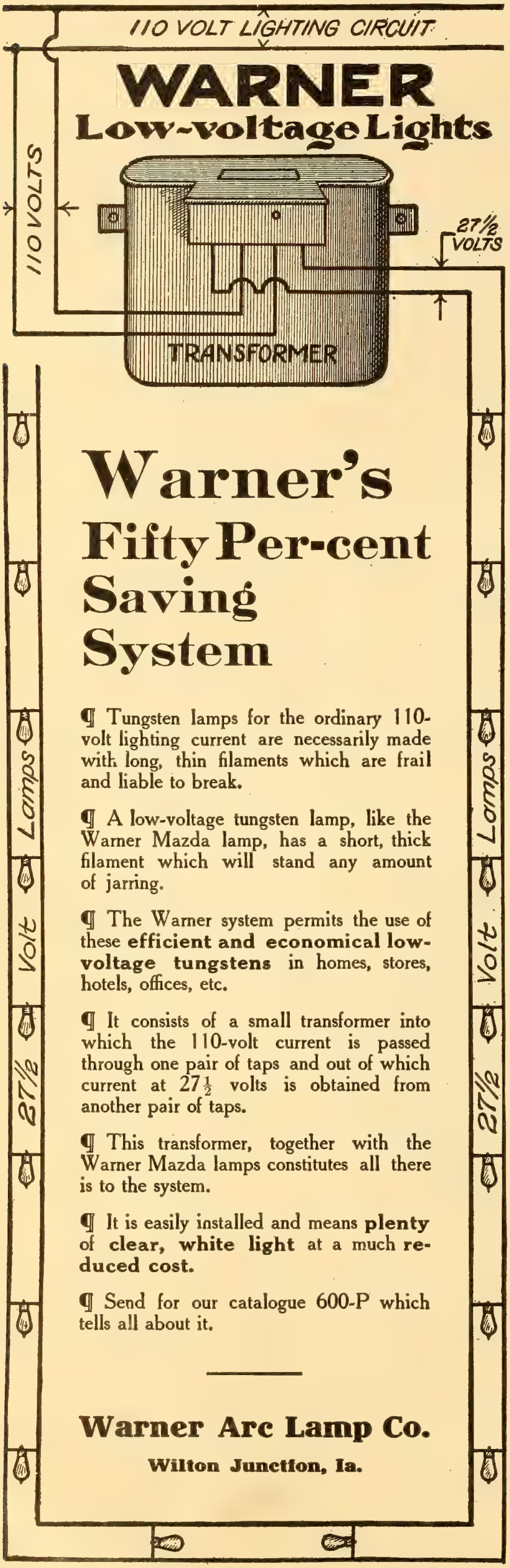

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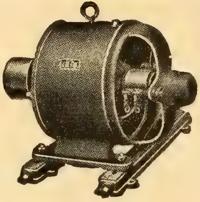

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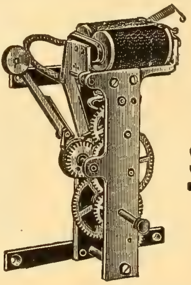

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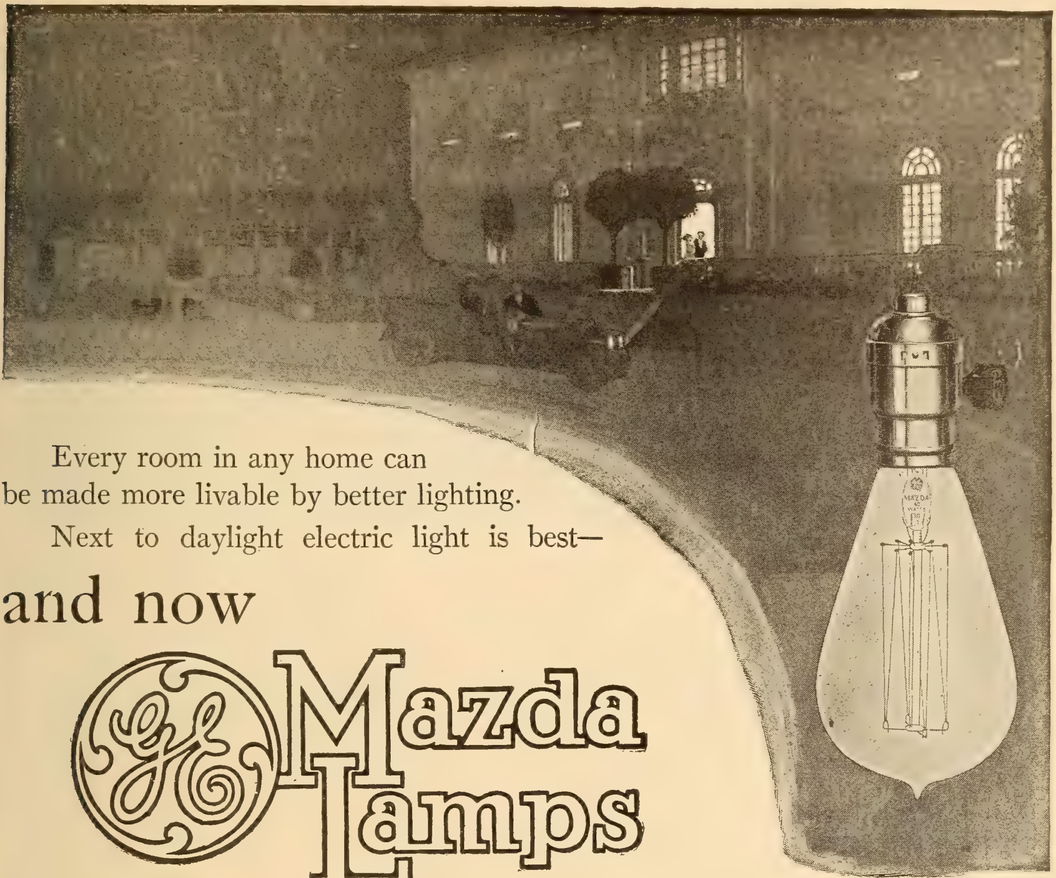
¶ In order that you may select to greater advantage before the holiday rush begins, we will mail you, free, our booklet, "Federalettes," which shows all of these popular electroliers.

¶ Make your selection now from our booklet. The various styles and low prices will interest you. Write for a copy of "Federalettes" today.

Federal Electric Company
MANUFACTURERS
Lake and Desplaines Sts. CHICAGO



Every room in any home can be made more livable by better lighting.

Next to daylight electric light is best—

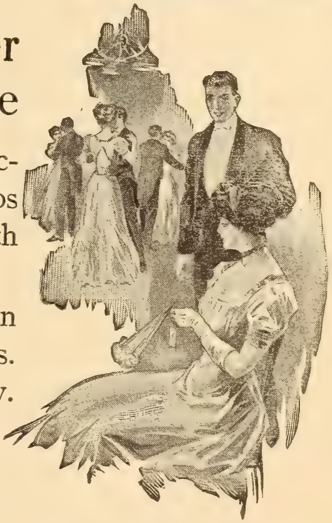
and now

GE Mazda Lamps

make electric lighting better and cheaper than ever before

Don't ignore—investigate. Old ideas of what electric light costs have been overturned. These new lamps deliver over twice as much light for every dollar's worth of electricity.

Electric light users find their lighting more than doubled with no increase in their "electric light" bills. That is what G-E Mazda lamps do for thousands today. They will do as much for you.



Ask your electric light man or dealer to furnish you the proper sizes. Begin with the rooms you want brightest. Get ready now for the long winter evenings.

General Electric Company
Dept. 30 Schenectady, N. Y.

We have prepared for you a helpful little booklet on the question of better lighting. Includes suggestions for wiring and lighting an eight-room house, cost of lighting, cost of lamps and the best ways to use them. Send for your copy today.

COLISEUM **JAN. 7-21, 1911**

Exhibitors Share The Profits

Sharing the Earnings

FOR the first time in the history of Chicago trade expositions, the exhibitors in the 1911 Electrical Show will be given a pro rata division of the earnings, and this dividend will undoubtedly bring the net cost of the exhibition space far below any former price. The price of space has not been increased.

Always a Winner

CHICAGO'S Annual Electrical Show is the most important trade exposition annually held in America and is international in its scope. It has always been the most successful of trade shows, never having had an attendance of less than 100,000 for the two weeks each year. The exhibitors include the representative electrical concerns of the world.

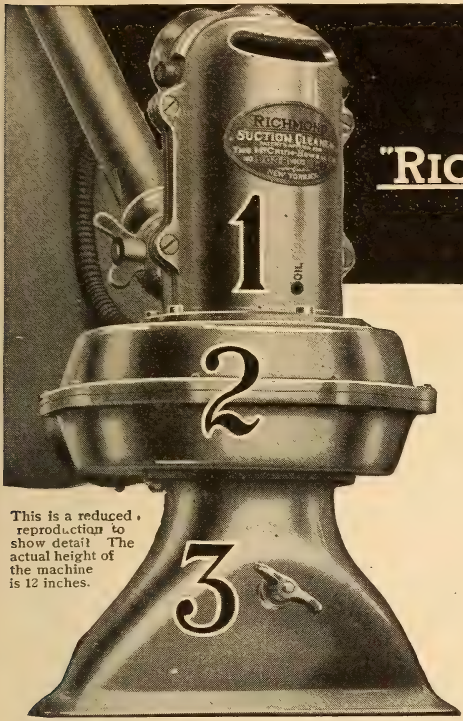
Get in an early application for space. For further information apply to

ELECTRICAL TRADES EXPOSITION CO.

Homer E. Niesz, Mgr.

150 Michigan Avenue **Chicago, Ill.**

One Dollar
Puts the "RICHMOND" Suction Cleaner in Your Home



This is a reduced reproduction to show detail The actual height of the machine is 12 inches.

ONE Dollar forever frees you from brooms, mops and dusters—and the backaches and drudgery they bring.

One Dollar forever stops the expense and the nuisance of Spring and Fall housecleaning.

One Dollar enables you to do, *easily*, by electricity, the *worst work* a woman has to do.

And One Dollar is the only cash outlay.

It will bring you the "RICHMOND" Suction Cleaner complete—ready for instant use.

The balance you pay for month by month out *of the actual money you save.*

For Vacuum Cleaning is the greatest of all household economies.

You are paying the price of a suction cleaner, *right now*—whether you have one or not.

You are paying its price out in twice-a-year house cleaning alone—for a "RICHMOND" makes housecleaning needless.

You are paying its price out—many times over—in the hard labor of sweeping and dusting which the "RICHMOND" makes unnecessary.

You are paying its price out again and again in the damage which dust does to your furniture, to your carpets, to your hangings, to your clothing—to YOU.

You are paying the price of a "RICHMOND" when a single dollar would save the waste.

YOU see here the lightest and simplest suction cleaner *ever designed.*

1.—is the motor—not a "stock" motor, but one built expressly to operate the powerful suction fan to which it is directly connected, under

2.—a suction fan which embodies the best of all that was learned in two years of steady, scientific experiment.

3.—is the suction nozzle which is pushed over the surfaces to be cleaned—or to which can be attached a twelve-foot hose for high wall, drapery and upholstery cleaning.

The "RICHMOND" Suction Cleaner enables you, now for the first time, to clean by electricity without lugging a 60 to 80 pound machine from room to room—upstairs and down.

It represents as great an advance over heavy weight vacuum cleaners as these cleaners represented over brooms and carpet sweepers.

But light weight and easy operation are but two ot the "RICHMOND'S" exclusive superiorities. There are many more.

The vibrating brush, which taps the caked dirt out of otherwise uncleanable rugs and carpets—the hair-drying and pillow-renovating attachments—the seven special tools which make the "RICHMOND" the most complete cleaner ever offered.

Manufactured exclusively for the RICHMOND SALES CO. by

THE McCRUM-HOWELL CO.

Park Ave. and 41st St., New York

Five Factories: Two at Uniontown, Pa.--One at Norwich, Conn.
One at Racine, Wis.---One at Chicago, Ill.

MANUFACTURERS OF "RICHMOND" Boilers and Radiators, "RICHMOND" Enameled Ware, Bath Tubs, Sinks, Lavatories, "RICHMOND" Suds Makers, "RICHMOND" Concealed Transom Lifts, and "RICHMOND" Stationary Vacuum Cleaning Systems

Inquiries regarding built-in-the-house Vacuum Cleaning systems should be addressed to The McCrum-Howell Co., New York and Chicago.

Limited Offer

The Dollar Offer is limited. It is made to show our unbounded confidence in the "RICHMOND"

But by its very liberality, it is bound to swamp the factory. And when the limit of factory output is reached, the offer must be withdrawn.

So send the coupon today while the opportunity is still yours! Don't wait. Do it NOW.

THE RICHMOND SALES CO.
Dept. 70, 160 Broadway, New York

DOLLAR COUPON

THE RICHMOND SALES CO., Dept. 70, 160 Broadway, N. Y. City

I hereby order one "RICHMOND" Suction Cleaner, complete with the following attachments:

1 Hose Attachment Shoe
1 12-ft. covered Suction Hose
1 Book and Wall Brush
1 10-in. Drapery Tool
1 3-in. Suction Tool
1 Felt-Faced Floor Tool
1 Adjustable Wall Brush
1 30-ft. Electrical Cord
1 Complete Hair Drying Attachment

—for which I agree to pay to your order, $1.00 herewith, and $6.00 on the first day of each of the next 12 consecutive months. Title to be given me when full amount is paid.

Name..

Address..

SMALL MOTORS FOR ALL PURPOSES

We manufacture motors (both alternating and direct current) for every small power purpose. We build them in sizes from one-hundredth horse-power up.

Regardless of what mechanical appliance you wish to operate, we can supply you with a Fort Wayne motor particularly adapted to your requirements.

No one motor ever built can run all kinds of devices equally well, so we have developed a variety of types to meet all conditions. For years we have been making the motors used on the leading vacuum cleaners, water pumps, meat grinders, washing machines, vibrators, etc. Tell us what you want to run and we will advise you what kind of a motor it will need and how much it will cost to buy and operate it.

Our new bulletin 1122 contains descriptions and illustrations of some twenty applications which have saved time and money for Manufacturers, Merchants, Doctors, Dentists, Housewives, etc. We want to mail you a copy—FREE. It will pay you to send for this bulletin and read it before you buy motors of any kind.

Fort Wayne Electric Works
"Wood" Systems

1603 Broadway
Fort Wayne, Ind.

Branch Offices:
Most Large Cities

For Driving Small Screws

Here's a "Yankee" driver—it's No. 35—that's made for the man who has many small screws to drive. Electrical workers or cabinet makers for instance. Right hand, left hand and rigid, and with its own special feature like all other

"Yankee" Tools

The blades to No. 35 are *straight*—not flattened like ordinary driver blades, so that they can be used to drive screws through holes and in out-of-the-way corners where a flattened blade would not go.

It's a driver that every machanic will find handy time after time. Light—weighs less than 7 ounces. And compact, for when closed—without bit—it's only 7 inches long. And yet it's strong and sturdy.

Yankee Screw Driver
No. 35 Price, $1.35

Your dealer can supply you.

Write us for the "Yankee" Tool Book. It describes and shows how to use the 66 "Yankee" Tools. Free, of course.

North Brothers Manufacturing Company
Philadelphia

Marketing Your Goods

is fully as difficult as making them. May be more so.

Advertising is modern marketing machinery.

You can buy this machinery—can you operate it?

Have you analyzed your selling problem?

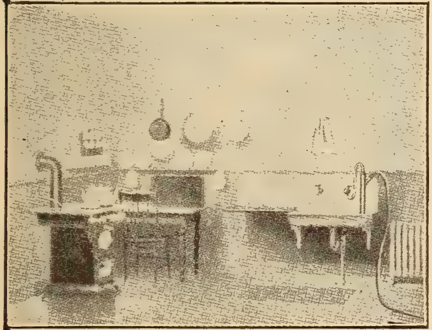
Do you know where a demand exists for your goods—the geography of distribution?

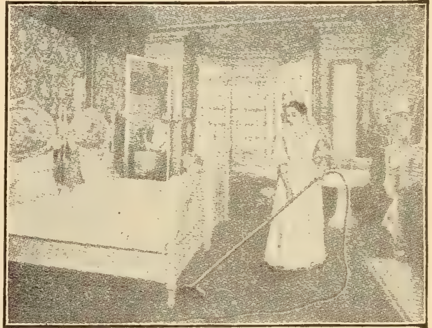
Do you know how to reach, at lowest cost, your possible customers—mediums of advertising?

Do you know how to prove the fitness of your goods to supply existing demand, how to describe them so as to create demand—effective copy?

If these questions suggest the need of outside help, get in touch with us.

WM. D. McJUNKIN
Advertising Agency
167 Dearborn Street, Chicago





A Water Power Vacuum Cleaner

Does the Work of an Electric with no Cost to Operate.
No Machinery--No Noise--No Dust Bags to Clean

All You Need is Water

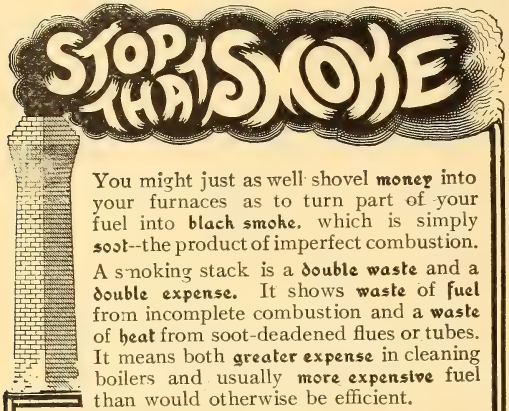
First Cost the Only Cost

We Want to Tell You About our Water Power Cleaner

It has many advantages over electrics and hand cleaners; is absolutely more practical, sanitary and economical; costs nothing to run; all the dirt and dust kept in one place and deposited in the sewer; can be used in any part of the house; has more suction and cleans better than any other vacuum cleaner manufactured; absolutely noiseless, light and convenient to handle; no labor to operate; no machinery to get out of order—you just simply attach it to your water faucet and operate it the same as other cleaners.

We want you to become interested in this cleaner at once. It absolutely revolutionizes the idea of cleaning by vacuum. Price more reasonable than other cleaners. It can be used by everybody.

PRESTO CLEANER CO. 114 Colonnade Building, TOLEDO, OHIO



You might just as well shovel **money** into your furnaces as to turn part of your fuel into **black smoke**, which is simply **soot**--the product of imperfect combustion.

A smoking stack is a **double waste** and a **double expense.** It shows **waste of fuel** from incomplete combustion and a **waste of heat** from soot-deadened flues or tubes. It means both **greater expense** in cleaning boilers and usually **more expensive** fuel than would otherwise be efficient.

In short, whenever your chimneys smoke,

You are Burning Money

We absolutely guarantee **The Scharf System** to cut out ninety per cent of your smoke and to effect a saving in fuel cost. The Michigan Steam Laundry, Detroit, writes: **"Saved $23.60** first 30 days and our stack now shows no smoke at all."

The Scharf System

The Only Automatic Smoke Preventing and Fuel Saving Device

Simple, reliable, safe and needs no attention. Gives perfect results while firing and all the time. Your engineer can install it, and without altering a single part of your boilers or shutting down the plant. Weighs but 100 lbs. complete. We sell it on an absolute guarantee. If you have several boilers, try it on one first. "We put on one two months ago" says The Evansville Brewery Ass'n. Evansville, Ind., "and now we have arranged to equip our remaining **eight** boilers with the Scharf System." There are in all two thousand of our machines in use today.

WRITE US for our proposition and new catalog. Tell us (without obligation) how many tons of coal you burn each day, at what cost, how many boilers and what h. p. each. We will tell you what we can save you.

THE G. H. SCHARF COMPANY
68 Huron St., Ypsilanti, Mich.

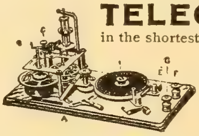
For Father, Son, Brother, Uncle, Nephew or Grandpa

$5.00 Safety Razor for Only 97 Cents

Beautiful silver plated, with stropper, handle and holder, a full set of Grains' Celebrated Wafer Blades, all in a handsome lined leather case, just like the high grade $5.00 outfits sold in stores. Remember this Special Advertising Offer is for a short time only in order to introduce in every city, town and hamlet in the United States.

All you need to do is to refer to this ad, enclosing **ninety-seven cents,** with your name and full address and the complete Grains' Safety Outfit exactly as described will be sent at once fully prepaid.

L. C. GRAINS COMPANY
184 Pulsifer Bldg. Chicago, Ill.



TELEGRAPHY TAUGHT

in the shortest possible time. The Omnigragh Automatic Transmitter combined with standard key and sounder. Sends you telegraph messages at any speed just as an expert operator would. Five styles, $2 up; circular free.

OMNIGRAPH MFG. CO.
39 H Cortlandt Street New York

VICTOR ELECTRIC CO.

Manufacturers of

APPARATUS ELECTROTHERAPEUTICAL

Our line includes the highest quality of

X-Ray Apparatus
Therapeutic Lamps
Giant Eye Magnets
Wall Plates
Cautery Transformers
Electric Sterilizers
Air Heaters
High Frequency Apparatus
Sinusoidal Apparatus
Diagnostic Lamps
Air Compressors
Bone Surgery Outfits
Vibrators
Faradic Coils

Correspondence of Physicians and Surgeons and Hospitals solicited.

55-61 Market Street, CHICAGO

For Men and Women Alike

A BOOK of VITAL INTEREST on the subjects of

MARRIAGE, PARENTAGE & SEXOLOGY

Comprehensive—Interesting—Instructive

Dr. Foote's "Home Cyclopedia"

of plain home talks is certain to awaken thought in every reflective reader; every page bristles with facts about self and sex and their relation to life and health. It imparts the information in a clear and wholesome way. It ought to be in the hands of every husband and wife, or those who ever expect to be either. It is written by a specialist of 50 years' practice. It contains 1,248 pages; 330 illustrations from color plates and half tones; cloth bound. It is endorsed by Physicians, Teachers, Clergymen, Lawyers, and others in all parts of the world. Send TODAY for our FREE descriptive booklet with table of contents, opinions of people, and other interesting matter, and also for our SPECIAL OFFER. Regular Price $2.00.

MURRAY HILL PUB. CO., 106 East 28th St., New York.

WALTHAM WATCHES ON CREDIT

No 43

BIG BARGAINS. Diamond Rings, any style mounting. Terms: $3.75 per Month.

Christmas Presents—Big Specials

FULL JEWELED WALTHAM $10.65

In Fine 20-Year Gold-filled Case. Guaranteed to keep Accurate Time

SENT ON FREE TRIAL, ALL CHARGES PREPAID.

You do not pay one penny until you have seen and examined this High-Grade, Full Jeweled Waltham Watch, with Patent Hairspring, in any style plain or engraved Case, right in your own hands.

Greatest Bargain Ever Offered $1 a Month.

No matter how far away you live, or how small your salary or income **we will trust you** for a high-grade adjusted Waltham Watch, in gold case, warranted for 25 years, and guaranteed to pass any railroad inspection.

LOFTIS BROS & CO. EST'D 1858
THE OLD RELIABLE ORIGINAL DIAMOND AND WATCH CREDIT HOUSE
Dept. P685 92 to 98 STATE ST., CHICAGO, ILL.
Branches: Pittsburg, Pa., St.Louis, Mo.

Write for our handsome Christmas Catalog, filled with beautiful photographic illustrations of Diamonds, Watches, solid gold Jewelry, Silverware and choice Novelties for Christmas presents. Select any article you would like to own or present to a loved one; it will be sent on approval.

"I MADE $88.16

first 3 days," writes Mr. Reed of Ohio. Mr. Woodward earns **$170.00 a month. AGENTS** all making money. Mr. M. L. Smith turned out $301.00 in two weeks. Rev. Crawford made $7.00 first day.

LET US START YOU

in Gold, Silver, Nickel and Metal plating. Prof. Gray's new electro plating machine plates on watches, jewelry, table ware and all metal goods. Prof. Gray's new Royal immersion process, latest method. Goods come out instantly with fine brilliant, beautiful thick plate ready to deliver—no polishing or grinding. Every family, hotel and restaurant wants goods plated.

AGENTS HAVE ALL THEY CAN DO— people bring it. You can hire boys to do the plating as we do. Men and women gather work for small per cent. Work is fine—no way to do it better. No experience required—**we teach you.** Outfits ready for work when received. Materials cost about 10 cts to do $1.00 worth of plating. *Demand for plating is enormous.* **WE ARE RESPONSIBLE** and guarantee everything.

Call or write today. Our new plan, testimonials, circulars and **SAMPLE FREE.** Don't wait. Send us your address anyway. **Gray & Co. Plating Works 505 Gray Building, Cincinnati, Ohio.**

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12 Art Panels 50c

Beautiful Duo Tint Reproductions of Famous Paintings—Panel Size 7x10

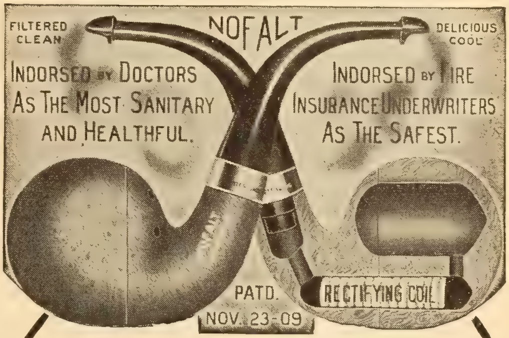
These pictures are real gems—the most exquisite portrayals of

"WOMAN BEAUTIFUL"

ever shown in one collection. We send a full set of 12 in a handsome Art Portfolio, packed flat and safe delivery guaranteed, together with 120 life-like miniature illustrations of other beautiful art pictures, for only 50c coin, money order or U. S. Stamps. **Send at once. Money back if not satisfied.**

FLORENTINE ART COMPANY
Dept. F. 12, 2009 Prairie Ave., Chicago, Ill.

FREE Order at once and we will include "**FREE**" a beautiful den picture in colors.


FILTERED CLEAN
NOFALT
DELICIOUS COOL
INDORSED BY DOCTORS AS THE MOST SANITARY AND HEALTHFUL.
INDORSED BY FIRE INSURANCE UNDERWRITERS AS THE SAFEST.
PATD. NOV. 23-09
RECTIFYING COIL

THE NOFALT PIPE

Incomparable with anything ever contributed to the Smoker's Outfit. Special attention is directed to the Sectional Engraving illustrating a RADICALLY NEW Principle in Pipe Construction. Tobacco Bowl and Rectifying Chamber Horizontally arranged. Smoke PURIFIED and COOLED while passing through ANTISEPTIC COIL. SALIVA Absorbed by Coil NEVER REACHES TOBACCO. Bowl Revolves on German Silver Telescope Tube. Swing open to light, close to smoke. TWO PUSH JOINTS. **No Screws.** CLEANED in half minute. Place in Pocket Lighted, No Danger, No Odor, **No Nicotine.**

If for any reason a purchaser of this pipe should fail to obtain **Satisfactory Results** *we obligate ourselves to make good or* **Refund the Money.**

The Nofalt Pipe is Skilfully and Correctly made of GENUINE FRENCH BRIAR, High Friction Finish, Solid Rubber Stem, Sterling Silver Mounted, put up in Individual box with (10) Rectifying Coils, (1) Nickel Plated Tamper and Cleaner and Illustrated Directions, Sent Postpaid for $1.00. Consult your dealer also.

THE IRVING INNOVATION CO.
Suite E, 335 Broadway, New York, N. Y.

Autology

Body and Brain Perfection

DR. MORAS has written a Commonsense Book on Autology, and by so doing placed the Standard of the Creed of Health Farther to the Front than any man who has lived for a thousand years—**Elbert Hubbard.** So you may see for yourself. Send for FREE "Guide to Autology." Address **E. R. MORAS, M. D., Dept. 12, Highland Park, Ill.**

CHARCO-DENTO

TRADE MARK

TOOTH PASTE AND TOOTH POWDER

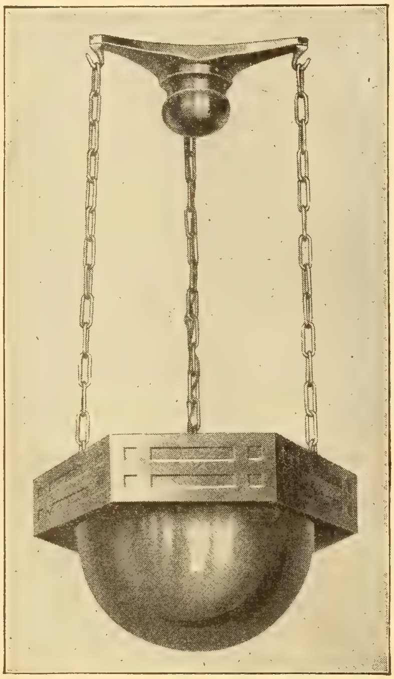
are improvements in dentifrice making as they contain charcoal, a natural absorbent, which will take up and carry away the acids and decayed matter which destroy the teeth. CHARCO-DENTO has every ingredient necessary to clean, preserve and beautify teeth and heal and harden gums. Your druggist has it or can order it for you. Price 25c in paste or powder form. Send 10c for a month's supply and booklet. GOE & CO., 1 GOLANE BUILDING, RIDGEWOOD, N. J.

CHARCO-DENTO will remove tobacco and all other stains from the teeth

At Last

it is possible to secure comfortable, even illumination throughout a room without a brilliant light in range of vision.

¶The **Eye Comfort System** of Indirect Illumination is the notable success in the lighting field.



If you are interested in the rational, beautiful illumination of any

- ¶ **Church,**
- ¶ **Residence,**
- ¶ **Office,**
- ¶ **Restaurant,**
- ¶ **Hotel,**
- ¶ **Store or**
- ¶ **Club**

write us for full information and photographs of installations in similar places that are attracting widespread, favorable attention.

WRITE TODAY

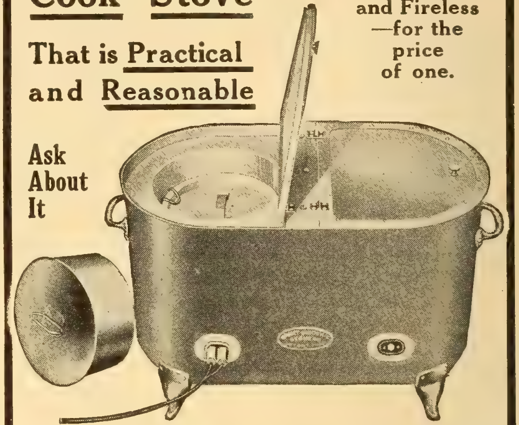
National X-Ray Reflector Co.
257 Jackson Boulevard
CHICAGO, ILL.

An Electric Cook Stove

That is Practical and Reasonable

Two kinds of stoves—Electric and Fireless—for the price of one.

Ask About It



The Comet Electric Stove is designed to save fuel. It does a day's cooking at the cost of burning an ordinary electric light less than one hour.

Reasonable to buy—convenient to use—economical for the Home, Camp, Motor Boat, or Automobile. You don't have to depend on electricity alone—it's a fireless cooker as well.

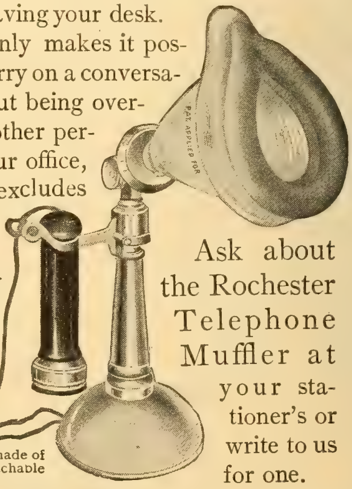
Ask us more about it now—today. Special prices to Central Stations and Dealers.

COMET ELECTRIC STOVE CO.
280-284 Eighteenth Street DETROIT, MICH.

The Rochester Telephone Muffler

provides all the privacy of a telephone booth without leaving your desk.

It not only makes it possible to carry on a conversation without being overheard by other persons in your office, but it also excludes all foreign sound, thereby improving the talking qualities of your telephone.



Ask about the Rochester Telephone Muffler at your stationer's or write to us for one.

And it is thoroughly sanitary, being made of glass with a detachable rubber mask.

Price, $5.00, C. O. D.

Rochester Telephone Muffler Co.
Wilder Building, Rochester, N. Y.

FLEXILYTE—THE PORTABLE ELECTRIC LIGHT

just as useful in the home as it is while traveling.

See if this is what you have been waiting for—a portable, flexible light, new and original—fully protected by United States and foreign patents.

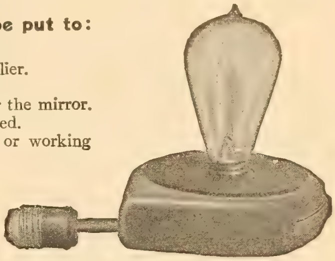
The case, as shown in the picture, contains 15 feet of cord, which you can pull out and fasten at **any desired length,** on any current with any incandescent lamp.

There is an attachment plug at one end of the lamp cord which you put into the fixture—into the Flexilyte you put the lamp which you have taken from the fixture. Then you lead the Flexilyte to any part of the room where you want the light concentrated.

Here are some of the people who are using the Flexilyte: traveling-men, house-managers, doctors, trained nurses, dentists, house-owners, shop-managers, actors, actresses, college students, apartment-owners, flat-dwellers, musicians, draftsmen and engineers.

These are a few of the practical uses it can be put to:

Reading in bed.
Reading or writing in a room dimly lighted by an electrolier.
Rummaging in a closet.
For shaving in a room where the lights are nowhere near the mirror.
For hunting collar-buttons that have jumped under the bed.
For concentrating light while doing mechanical drawing or working over plans.
For concentrating on fine mechanical work, such as in the optical or jewelry business.
For throwing light on the music rack of a piano.
For any occupation, pastime or amusement where light is an essential.



Every live Electrical Dealer, Department Store, Jeweler and Optician is selling these Flexilytes now. Get one at once and save eye-strain and the thousand and one annoyances to which you are being put all the time, because you cannot get the light just where you want it.

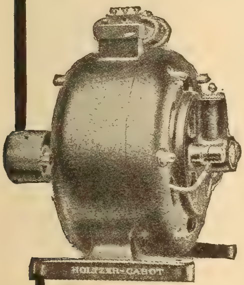
If your dealer has not got Flexilytes in stock yet, we will send direct, express prepaid, on receipt of the list price, $5.00.

Don't put off, act now.

L. A. WILLIAMSON CO.

79 MILK STREET **BOSTON, MASS.**

Motors for all Purposes—1-20 to 1-2 H. P. Single Phase



Holtzer-Cabot Motors are made for all kinds of purposes—washing machines, vacuum cleaners, adding machines, ozone machines. Any mechanical appliance requiring motors from 1-20 to 1-2 H. P. are absolutely perfect when carrying

Holtzer-Cabot Motors

We make a specialty of single phase alternating current motors and build them from manufacturers' designs and on specifications.

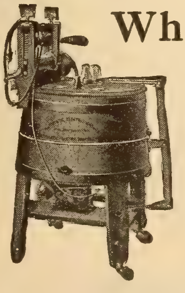
Absolutely perfect in workmanship and electrical design.

We will send you our catalogue 330-D immediately for the asking.

THE HOLTZER-CABOT ELECTRIC CO.

621 Albany St., Boston, Mass. **6161-65 S. State St., Chicago, Ill.**

When You Buy



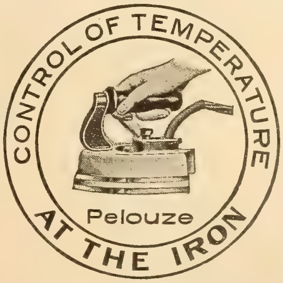
Why pay more than we ask for an electric washer? Our prices are reasonable, our machine is the most complete regardless of price.

Send today for booklet of information.

Automatic Electric Washer Co.

Box 100, Newton, Iowa

Pelouze Electric Iron



Consumes less current than other irons

The only Electric Iron in which the current and temperature can be controlled at the iron.

The Iron that Guarantees Satisfaction.

No Fire No Dirt No Odor

Every Iron Guaranteed

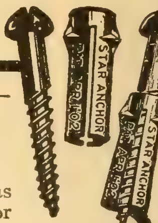
4 lb.	6½ lb.	9 lb.	20 lb.
$5.00	$5.00	$7.00	$12.50

For Sale by Leading Dealers

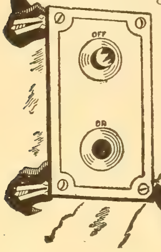
PELOUZE ELECTRIC HEATER CO.

232 East Ohio St., CHICAGO, ILL.

Where Ordinary Screws Pull Out
USE STAR SCREW ANCHORS



Anywhere an ordinary bolt or screw is unsafe—in a tile, brick, stone or concrete wall—for fastening push bells, motors, and every electrical fixture, you will find



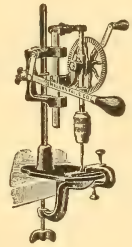
STAR SCREW ANCHORS

invaluable. A quick, easy, absolutely dependable means of fastening, twice as cheap and ten times more efficient than the old methods of wood plugging or "working in" with lead.

We'll trade a new catalogue number 10 and free working samples for your name and address. A postal now.

STAR EXPANSION BOLT CO.
Catalogue Dept. 10, 147-149 Cedar St. NEW YORK CITY, N. Y.

Our Drill Press No. 23



will be found an exceedingly useful and convenient tool for light work. The frame is made of steel and iron japanned. The feed is supplied by a compound lever, which is convenient, sensitive and effective. The chuck holds drills from 0 to ⅜ of an inch. The distance from chuck to table with sliding frame at highest point is 6½ inches Weight 8½ pounds. Price each $3.50..

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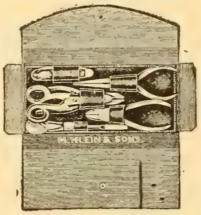
SPECIAL PRICE FOR DECEMBER ONLY
A Useful Gift to your Friend as a Christmas Present

Klein's Electrician's Pocket Tool Kit

No. 403K Kit, complete with Tools, $5.50 Net, Postpaid



Genuine leather case, contains a selection of Klein tools such as have been found particularly desirable by electricians and wire men on switchboard and telephone work. It is of convenient pocket book style, with firm metallic clasp and measures 4x9 inches. It contains the following tools: 1 single blade electrician's knife, 1 5-inch Klein side cutting pliers, 1 5-inch Klein oblique pliers, 1 6-inch Klein long nose side cutting pliers, 1 3-, 1 2-inch blade screw driver and 1 pair 5-inch N. P. electrician's snips.

Note—The pliers are plain black finish; if nickel-plated pliers are wanted add 25 cents net, each, for plating.

Case furnished either russet or black color

Send 4c in stamps for 66 page catalog, showing full line of Electrician's, Lineman's Tools,

MATHIAS KLEIN & SONS, Station U-3, Chicago, Ill.

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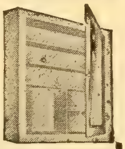
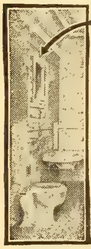


THE only modern Sanitary Steel Medicine Cabinet or Locker. Handsome beveled mirror door. Snow white, everlasting enamel, inside and out.



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Costs less than wood and is better.

Should be in every bathroom. Is dust, germ and vermin proof and easily cleaned with warm water.

Made in four styles and three sizes. Price $7.00 and up.

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Pocket Knife Tool Kit.

Every one has use for a **Knife, Reamer, File, Saw, Chisel, Screw Driver or Cork Puller.** This outfit is practical, yet so small, being contained in a **Leather Pocket Book** 4¼x3¼ inches, is, by carrying it in your pocket, always at hand for immediate use, whether **Camping, Boating, Teaming, Driving,** in the **Shop, Factory, Office, Store, Warehouse, Automobile,** on the **Farm, Bicycle,** or around the **Home.** Any **Tool** firmly attached or detached to the **Pocket Knife** in a second.

Sent Post Paid on receipt of price, $2.25.

Use it five days and if not satisfactory return it and we will refund your money.

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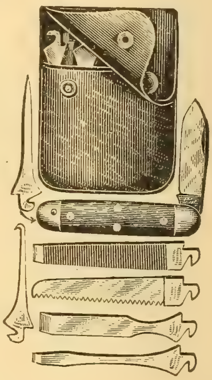

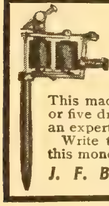

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This machine can be operated on any 5-volt battery circuit (four or five dry cells give plenty of current) and anyone can become an expert at the art by using my machine and methods.

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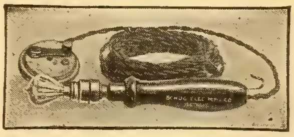

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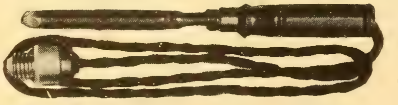
Detroit, Mich. "Dept. W."



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All irons are guaranteed for a period of 6 months constant service. Write today for particulars, and our 10 day free trial offer.

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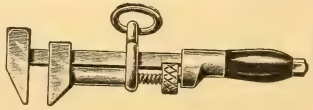

Perfect Working Model Wrench 1½ in. long. Regularly sold for 50c, will be sent postpaid to readers of Popular Electricity on receipt of this advertisement and ten two cent stamps. Offer good until Dec. 25th. **SMITH & HEMENWAY CO., 108 Duane Street, NEW YORK. (Manufacturers of the famous "Red Devil" Tools).**

This Kerosene Engine Cuts Your Expenses 75%

YOU should not even consider engines that operate on gasoline only. The rapidly rising price of gasoline, now 6 to 16 cents higher than kerosene, absolutely makes operation on this fuel too expensive. The Perfection Kerosene Engine operates on **any** engine fuel. When you purchase it you are on the safe side—proof against all fluctuations of the market. You can always run this engine at a great fuel saving and get the greatest amount of work done. The Perfection **vaporizes its own kerosene** and so makes it as efficient as gasoline—something other engines **cannot** do.

The Perfection is very light, portable, has only three moving parts, runs everything about the place, is lower in price than any other engine of its capacity on the market.

PERFECTION Kerosene Engine

Sent You on 15 Days Free Trial

See your dealer at once and ask him to let you have a copy of our **Free ENGINE BOOK,** which shows the sizes and styles of the "Perfection" and explains this very attractive offer. Your dealer will send any "perfection" engine to your farm for 15 days and let you return it if you are not satisfied. Ask him about it. If he does not carry the "Perfection" write to us and we will send you our **Free Engine Book** direct.

CAILLE PERFECTION MOTOR CO.
202 Second Ave., Detroit, Mich.

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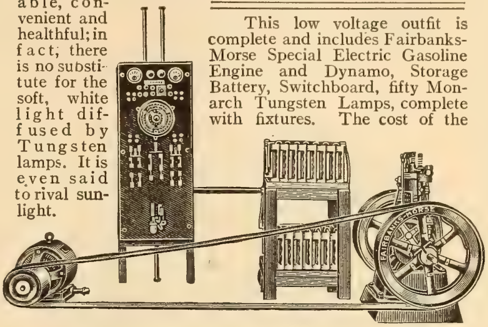
Why use unsanitary oil lamps or dangerous gas, when you can obtain electric light from your own plant at the actual cost of generating current.

This outfit gives an economical light that is safe, reliable, convenient and healthful; in fact, there is no substitute for the soft, white light diffused by Tungsten lamps. It is even said to rival sunlight.



This low voltage outfit is complete and includes Fairbanks-Morse Special Electric Gasoline Engine and Dynamo, Storage Battery, Switchboard, fifty Monarch Tungsten Lamps, complete with fixtures. The cost of the whole equipment is $500, and it will last for years at a very small maintenance expense.

The directions are so simple that an inexperienced person can soon master the details. It is absolutely safe and there is no danger of an explosion.

The same engine can be used for operating a water supply system or other machinery. We also make larger electric light plants up to 500 horse power in single units.

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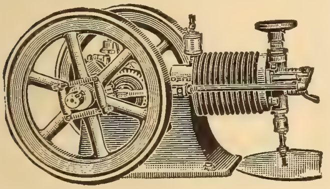

so you can test it out and prove to yourself it's the best little all-around gasoline engine ever produced. It is adapted for all uses in Shop, Farm and Home. We ship complete—all set up and connected—ready for use. It's so simple a woman can run it—simply fill in the gasoline—give it a turn and away it goes.

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are built on correct lines. Piston and rings are of special design, like those in the finest motor car engines. Let us send you free book and tell you all about our wonderful 30-Day Free Trial Offer. **Write today.**

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1/12 AND 1/8 Direct and Alternating Current Motors

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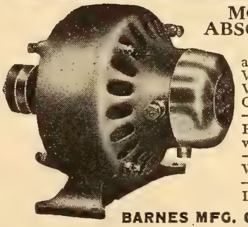

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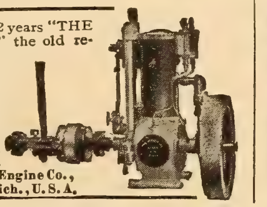

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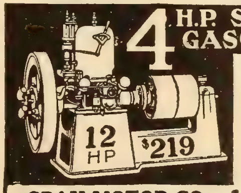
4 H.P. STATIONARY GASOLINE ENGINE COMPLETE $76.00



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If you are out of reach of central station current and wish to install a gas engine electric outfit, either with or without storage battery, write for our Handbook, here illustrated. Alamo Electric outfits are standard. Our prices are as low as consistent with high-grade machines suitable for permanent installations. Investigate our proposition, it places you under no obligation.

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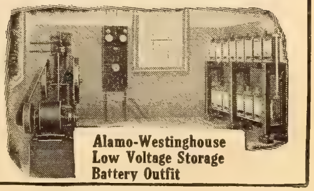

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Advertising claims are not worth the ink wasted on them, unless they can be backed up by performances. We use space month after month to tell you that Murdock-Made goods **can perform.** Consider our

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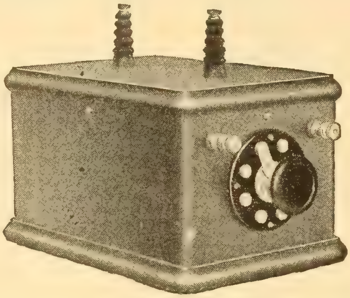

and our claim that it is UNEQUALLED for WIRELESS. Then try it. You will understand what performance means. For 110 Volt. A. C. Prices on request.

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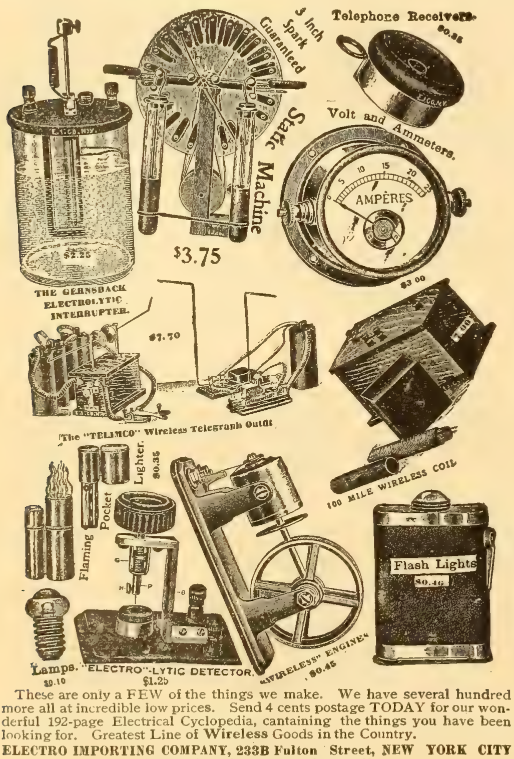

These are only a FEW of the things we make. We have several hundred more all at incredible low prices. Send 4 cents postage TODAY for our wonderful 192-page Electrical Cyclopedia, cantaining the things you have been looking for. Greatest Line of **Wireless** Goods in the Country.

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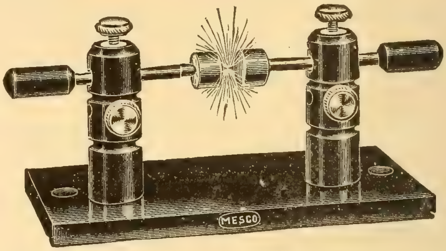
WIRELESS TELEGRAPHY



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Catalogue No. 24B, 180 pages of general electrical supplies, mailed on request.

Manhattan Electrical Supply Co.

MESCO TRADE MARK
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Belden Magnet Wire

Our SILK and COTTON covered MAGNET WIRE is accurate to gauge with insulation of perfect uniformity and continuity and is put up one piece only per spool.

Beldenamel Magnet Wire is insulated with several layers of tough elastic enamel separately applied and baked onIt possesses the highest insulating strength and will not become brittle and flake off.

We quote the following net prices to readers of this paper and will ship postage or express prepaid on receipt of cash. **No orders filled amounting to less than $1.00.**

Prices are per pound.

Size	Single Cotton	Beldenamel	Single Silk	Double Cotton	Double Silk
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17			.49		.62
18			.50		.64
19			.52		.65
20	.35	.48	.53	.38	.67
21	.36	.49	.54	.42	.69
22	.37	.51	.55	.44	.73
23	.39	.53	.58	.47	.77
24	.41	.56	.61	.50	.83
25	.44	.60	.66	.55	.89
26	.48	.66	.72	.60	.99
27	.52	.71	.78	.66	1.11
28	.55	.77	.84	.72	1.20
29	.59	.84	.92	.78	1.33
30	.65	.93	1.02	.85	1.54
31	.74	1.06	1.15	.92	1.85
32	.77	1.19	1.30	.98	2.04
33	.86	1.35	1.48	1.13	2.40
34	1.04	1.60	1.74	1.32	2.76
35	1.12	1.86	2.03	1.60	3.17
36	1.27	2.16	2.35	1.80	3.59
37	1.62	2.56	2.80	2.58	4.42
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39	2.82	3.72	4.05	4.32	5.85
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"BROOKLYN WIRELESS" Mark of Quality.....Nuf-Sed

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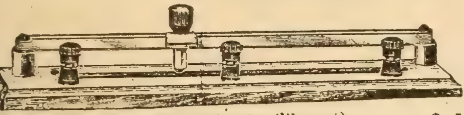

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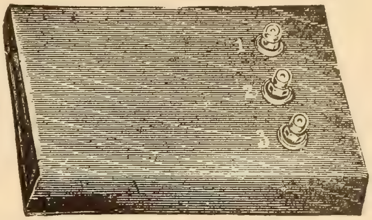

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Brooklyn Wireless Co., Inc., 766 Broadway, Brooklyn, N. Y.

PERMANENT MAGNETS
MADE TO ORDER
Tungsten or Manganese Steel

Write for quotations sending drawing and specifying quantity wanted.

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XMAS SPECIAL

Our T. A. T. 2800 ohm set, with gold plated diaphragms, and sterling plated bobbins, complete, only $8.75.

One of the most sensitive, lightest in weight, best and neatest made receivers on the market today. We guarantee them. Money refunded if not absolutely satisfied. Send for catalog. **C. BRANDES, 111 BROADWAY, NEW YORK.**

ENAMEL INSULATED FRENCH *Feval* PROCESS **MAGNET WIRE**

ENAMEL WIRE is supplanting silk and cotton covered because **The Insulation is better,** because **It requires less space,** because **It is cheaper.**

FEVAL WIRE has a dielectric strength in excess of 75 volts per .0001 inch of insulation. The evenly distributed enamel covering adheres tenaciously yet is resistant and elastic, never cracking. No change at 400° to 500° F. All sizes, Nos. 16 to 40.

MANUFACTURERS: We have an attractive contract proposal to offer covering your requirements for 12 months.

INDIVIDUALS: We will furnish small quantities for spark coils and magnets.

FEVAL ENAMEL INSULATED WIRE CO.
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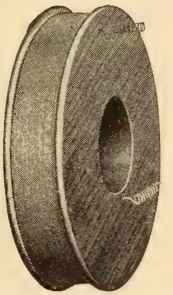

Been having trouble winding your Secondary for your Induction Coil or Transformer? Why not put your worries on our shoulders? The winding is not a WORRY to us, as we have the equipment, and winding coils is a part of our BUSINESS.

Our Secondary "UNITS" are wood spool sections wound, parafined, etc., and all ready to connect up. You can buy a spool at a time or as many as you want, and they will cost you but little more than the wire alone,

Send 2-cent stamp for our large catalogue which tells all about it and many other things "WIRELESS" besides.

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Our Wireless Goods are the best on the market, and are guaranteed to *work*. Our instruments are made of the finest materials, and are sold at present at a price within the reach of every experimenter. Send 2c stamp for our large catalogue which contains a full list ot Wireless Instruments, Novelties and Electrical Goods, and also a great deal of Wireless information for the Wireless experimenter.

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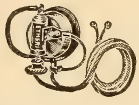
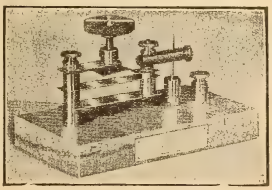
NEW WIRELESS WONDER



Aero-Field Receiving Outfit. Weight only 4 oz. Receives up to 75 miles. The Wireless Sensation of the year. Consists of 1000 Ohm, receiver and attachments all assembled on regular size leather insulated head band. Price $4.00 (not including light field aerial). A wonderful instrument at a wonderful price. Boy scouts and all requiring light outfits send 2c for description of the Aero and catalogue. **Etheric Electric Co.,** Salesrooms and Factories, 278 Lenox Ave., cor. 124th St., 71 Barclay St., New York, N. Y.

Anything Electrical or Wireless



Ferron Detector, $5.00

Get Your Xmas Tree Outfits and Novelties NOW

Send a four cent stamp for our NEW BIG 200-page catalog. Unquestionably the largest and most complete wireless and electrical catalog published. Twice the size of our last catalog, which was as large as any published.

20 large sections of wireless and electrical goods. Get this catalog before purchasing Christmas novelties. Special prices on Xmas tree outfits, import toys, miniature trains, experimental wireless instruments, motors, dynamos, flashlights, etc.

This catalog contains 60 pages of wireless instruments for commercial and marine installation, the transmitting sets ranging from ¼ K. W. to 5 K. W., and also a great many experimental sets costing but a few dollars.

Our $19.00 receiving set has a demonstrated, proven range exceeding 700 miles, from only a 2 K. W. station. The exceeding delicacy and admirable adjustment of our Ferron Detector; the fine selectivity and accurate tuning obtainable only with a tuning coil wound with bare copper wire, and by an exclusive method, protected by patent, and the unquestioned superiority of our 1000 ohm Western Electric double head set, renders ordinary what would be considered extraordinary with any other receiving set of equal price.

J. J. DUCK, 428 St. Clair St., TOLEDO, OHIO

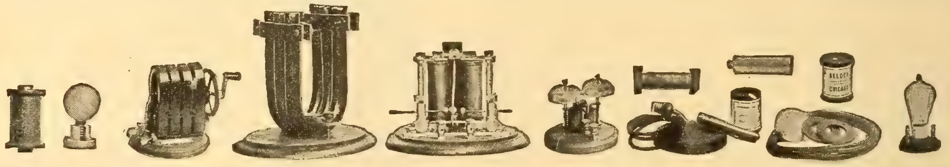
Christmas Outfit

This Complete Electrical Experimental Outfit for $5.

1—Magneto-Generator, weight five pounds, has brass gear drive, silk wound armature, bronze bearings and handle.
2—Ten Brass 15 cent binding posts. 3—110 volt 16 c. p. lamp and base.
4—Two small 4 c. p. lamps for generator with standard sockets.
5—Three six-inch bar magnets, iron filings and compass.
6—Four Electro-magnets with handle, 5, 10, 20 and 50 Ohms Resistance.
7—Six Blue Prints of fifty electrical diagrams.
8—Complete parts (14) for the construction of Gas spark coil.
9—Complete parts for the construction of a signal, including wood base, red and green incandescent lamp, contacts, wire, tape, sleeving, empire cloth, shellac and instructions.
10—Complete Polarized Interrupter Set, Switch, wire and screws.
11—Relay 100 Ohms. 12—Telephone Induction Coil. 13—Three stamped addressed envelopes to our electrical instructor.

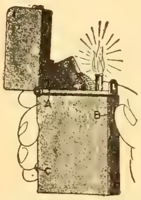
Your Christmas Present From Us Upon receipt of your order and five dollars we will send you FREE, a 250-page Electrical Instruction Book—and for one dollar extra we will send you a complete long distance telephone worth $7, mahogany finished case, regular size, with standard transmitter, receiver, induction coil, hook and ringer set. Act quick if you want a telephone.

Western Electric Salvage Co., 1224 So. Washtenaw Ave., Chicago, Ill.

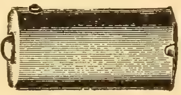


Wireless Supplies and Electrical Novelties

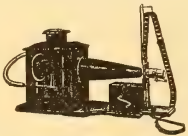
FOR HOLIDAY GIFTS



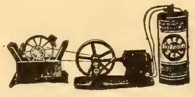
Combination pocket light and cigar lighter. The best metallic friction spark lighter on the market. Will last a lifetime. Press the button, the lid springs up, and the sparks from the "Ceric-Iron" pill ignite the wick. Unscrew valve and fill with 40 drops benzine, gasoline or alcohol which will last 8 days. Benzine preferred. Regular price $1.50.
Our price. By mail postpaid.........**95c**
Extra "Ceric-Iron" refill Pill.........**10c**



Nickel Tungsten Flashlight, with (new process) Merchlor Battery, and enameled Tungsten Bulb.
Price by mail postpaid...........**95c**
In silver finish.................**$1.35**
In gold finish.................. **1.50**
Extra Battery (Merchlor).........................**25c.**
Extra Tungsten Bulb (flat).........................**35c.**

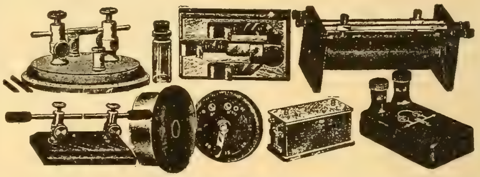


Acetylene Moving Picture Machine. Throws a 5x5 picture 20 feet. 500 candle power. Safer than kerosene oil. Regular price, $10.00.
Our price, with 5-ft. film.....**$6.35**
Electric..................... **9.60**

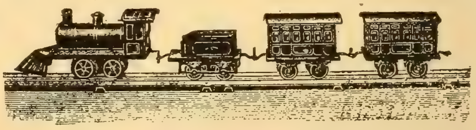


Electric Engine Outfit. Red Seal battery, engine and water bucket.
By Express...................**$ .95**
With extra piece of shafting and wind mill added........**1.35**

We carry a complete stock of Wireless Goods, Flash Lights and Batteries, Tungsten and Carbon Battery Lamps, Telegraph Outfits, Motors, Engines, Trains, Toys, and Pocket Cigar Lighters.



Complete Wireless Outfit. Will receive 50 miles, and send two miles. Consisting of Auto Coherer, Receiver, Fixed Condenser, Double Slide Tuning Coil, 1-inch spark Coil, Rheostat Regulator, Key, Spark Gap, and 1 pound aluminum wire. Will operate on from 4 to 6 dry cells, and can be tuned perfectly. Regular price $11.50.
Special, by express.................................**$9.35**



No. 2 Complete Electric Train Outfit, consisting of Locomotive, Tender, 2 trailers, and set of third rail track (2 straight and 4 curved). Will operate on 1 or 2 dry cells.
Holiday price, complete, by express **$1.65**

No. 9. Larger Locomotive with headlight, larger trailers, and 4 sections straight and 4 sections curved track. Price complete.....**$3.90**
Extra sections (1 foot) third rail track...............................**15**

Send 4c stamp for our Wireless Booklet and General Catalog of Electrical Novelties.

PRICES: Wireless Booklet, Net; Large Catalog, 20 per cent Discount.

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Known as LA SALLE LIGHT STORE
70 La Salle Street (Opposite the New City Hall), CHICAGO

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THORDARSON'S TOY TRANSFORMERS

Attach to any alternating current lamp socket and have a miniature Power Plant of your own. Operates any class of electrical toys, rings bells, lights small lamps and does any of the dozens of things you want to do. **Indestructible.** Besides the fun you get you learn the fundamental working principles of electricity—no more battery trouble. Show this to your father.

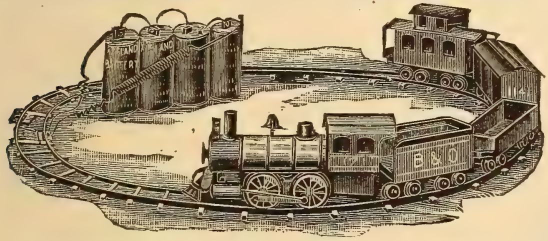
Write us for descriptive circular

Thordarson Electric Mfg. Company

220 So. Jefferson St., Chicago

ELECTRICAL TOYS FOR BOYS

SOME CHRISTMAS SUGGESTIONS { **SCIENTIFIC ELECTRICAL NOVELTIES** **Practical, Complete, Durable, Harmless**



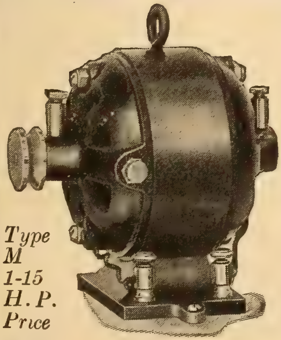
EVERY boy in the country can easily *own* a railroad. Costs little and pays big dividends in fun. Our Models of Locomotives, Trains, Trolley Cars, Dynamos, Lamps, etc. are practicable and durable inventions. Equipped with dry batteries, no acids or liquids used, perfectly safe and harmless. Electrical toys instruct as well as amuse.

Catalog B, fully illustrated, quoting low prices—SENT FREE.

THE CARLISLE & FINCH CO.

264 E. Clifton Ave., Cincinnati, Ohio

Largest Manufacturers Electrical Novelties in the World.



Type M 1-15 H. P. Price $5.50

New Toy Motors For Boys

WITH ALL THE LATEST IMPROVEMENTS

WOUND FOR 110 VOLTS BOTH ALTERNATING AND DIRECT CURRENT

No more trouble or expense with batteries. Simply use an attachment cord connected to any lamp socket. The best motors made for operating mechanical toys, models, advertising devices, 8-inch fan blades, etc. No boy's experimental laboratory complete without one of these motors. *Exact reproductions of large commercial motors* beautifully finished in black enamel; brass parts polished.

TYPE C.	**1-30**	**H. P.**	**WEIGHS**	**2 1-4 LBS.**	**$3.50**
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Type C. and D have field ring made in one piece. Type M. has laminated field and armature built of the best grade of electric sheet steel, 3-16-inch self-adjusting carbon brushes, mica insulated commutator, long bronze bearings, brass oilers, large brass pulley and brass terminals. This is the most efficient small motor on the market. Positively will not run hot.

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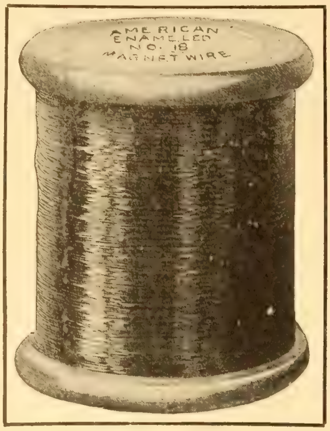

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ROCK ISLAND
NEW PATENT
DRY CELLS

are the batteries that **save you money.** Last so much longer and have greater recuperative powers. Whether for gas or gasoline engines or **any** purpose for which a dry cell is needed—be sure it's Rock Island Battery to get **best** results.

Price 25 cents.

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THE ROCK ISLAND BATTERY COMPANY
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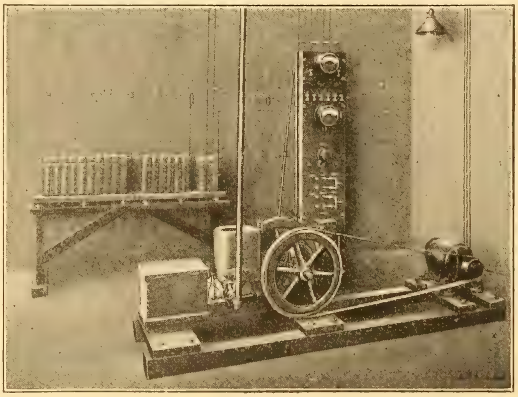

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Every suburban home, farm, factory, hotel, etc., not reached by a public lighting station can now have, at a small expense, all the advantages of electricity which are enjoyed by city inhabitants.

This Company has designed small electric lighting plants, that are inexpensive, require small space, can be set up and operated by anyone and give an absolutely dependable and continuous service—day or night. Complete plants are furnished for

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A complete plant consists of a small Gas Engine, Dynamo, Storage Battery and Switchboard. It is only necessary to run the engine a few hours occasionally to charge the battery furnishing current at all other times. These plants are guaranteed as represented by us. Small motors for various industrial and household purposes can also be operated with these plants.

The storage battery used is the **"Chloride Accumulator"**. This battery is exactly the same type of battery as is used by the large electric lighting companies, railways, telephone and telegraph companies, etc.

If you are interested, write our nearest sales office for our book *"How to Have Your Own Electric Lighting Plant,"* state the number of lights you wish to install, and let us show you how easily and cheaply you can have an electric lighting plant. If you are an electrical dealer, send for our special dealers proposition.

THE ELECTRIC STORAGE BATTERY CO.
1889 **PHILADELPHIA, PA.** 1910
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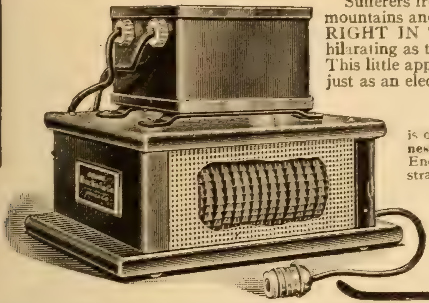
The largest maker of storage batteries in the country.



Let Electricity Make Pure Air for You

Sufferers from many ailments travel thousands of miles to breathe the OZONE of the mountains and pine forests. Yet a recent scientific invention enables everyone to have—RIGHT IN THEIR OWN BEDROOM—air constantly as pure, refreshing and exhilarating as the purest oxygen-filled atmosphere of the piny woods and mountain peaks. This little apparatus is operated by electricity and "ozonizes" the air of the closest room just as an electric storm purifies the out-door air. The

OZONE PURE AIRIFIER

is of greatest benefit in the treatment of **Asthma, Hay Fever, Catarrh, Insomnia, Nervousness, Pneumonia, Typhoid and Scarlet Fevers, Diphtheria, Bronchitis, Tuberculosis, etc.** Endorsed by highest medical and scientific authoritiesa thoroughly tested and demonstrated success.

Central Station, Electric Jobber and Dealer, this is the latest Electrical Appliance on the market. Write now for illustrated catalogue, price list and descriptive matter and plan of placing for liberal trial.

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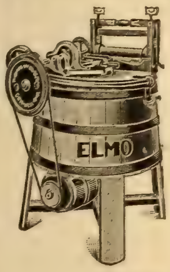
The Lid can be Raised While the Washer Runs



This exclusive feature of the Elmo Washer means quicker, more economical washing, and saves frequently stopping and starting the machine.

The lid is light and easy to raise. You don't have to lift a lot of heavy machinery. Besides

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has positive action wringer, back gear drive principle—noiseless and power-saving, protected motor and other desirable features too numerous to mention here. We tell you all about them in our free booklet. Write for it and learn how a perfect washer works.

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GRINNELL, IA.
CANADIAN TRADE SUPPLIED BY
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THE RAREBIT or other Chafing Dish recipe made in the Simplex Electric Chafing Dish is always uniformly good—because the heat is always uniform and constant, ensuring the same results in successive cooking operations. The Simplex Electric Chafing Dish is safe, clean and economical, and adds an interest of its own to the social evening.

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SUCTION CLEANER
BEE SALES CO.
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***Only* RELIABLE AGENTS**

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It leads because of these **facts.** Price, complete with all attachments, **$60.00.** Weight, only 20 lbs. No jar or vibration. Runs on either current without adjustment. Best work with the least effort and guaranteed.

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Save 35 to 70%

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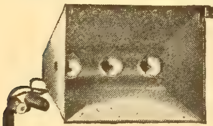

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Light-Bath
$12.50

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The rays of light are projected by a powerful parabolic reflector directly perpendicular to the body to which the Radiotherm is applied, entering beneath the skin and penetrating the affected tissues.

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"THE BEST IRONER"

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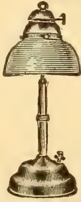

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A beautiful lamp for homes, hotels, offices, stores, banks, cafes. Portable, safe; can be turned upside down or rolled on floor without danger or affecting the light. 300 C. P. of soft, brilliant light; one-third cent per hour.

Agents—We want town, county and travelling salesmen. Best proposition ever offered. Sells everywhere. No experience necessary. Write for Special Offer.

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Delivered East of Omaha and North of Ohio River
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The entire outfit **must satisfy you** or you pay nothing. Isn't this worth looking into? Could we offer such liberal terms if we didn't know that the **Hess Furnace** excels in service, simplicity, efficiency, economy?

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possess all the features needed to make battery circuits complete and successful in operation.

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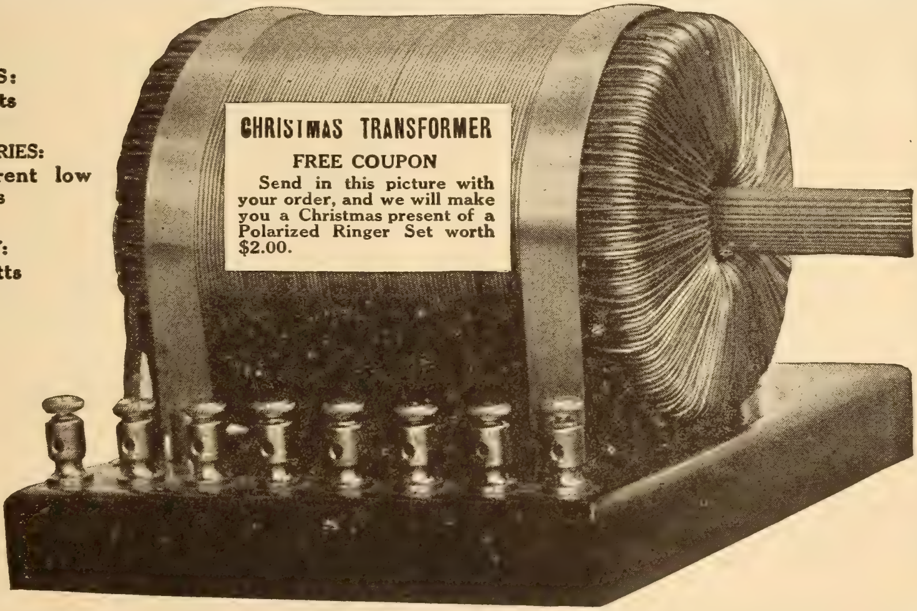

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Looks and colors like meerschaum. Absorbs the nicotine and **keeps on tasting sweet.**
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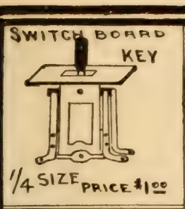

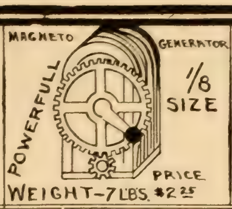

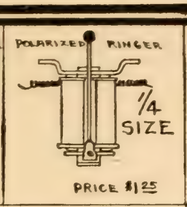

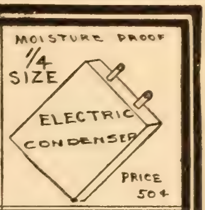

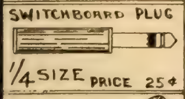

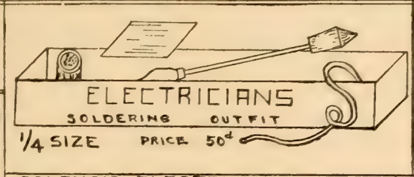

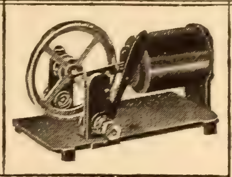
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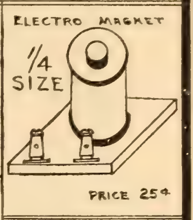

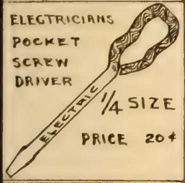

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The entire **31** Electrical articles shown on this page, all assembled, tested and ready for practical or experimental use, together with one ELECTRICIAN'S HANDY SUPPLY BOX, containing **24** additional, different and useful supplies, all for

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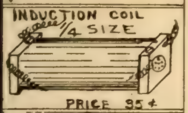

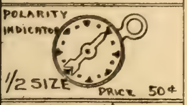

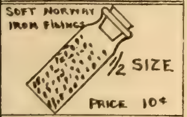

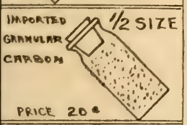

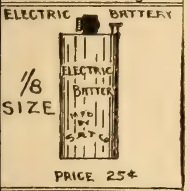

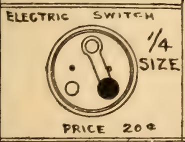

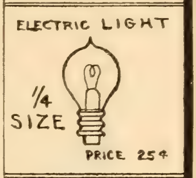

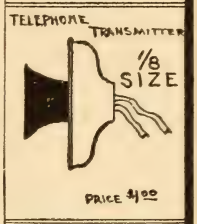

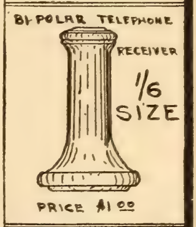

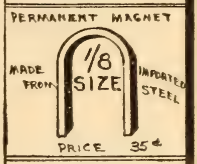

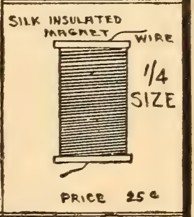

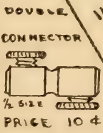

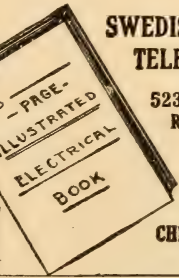

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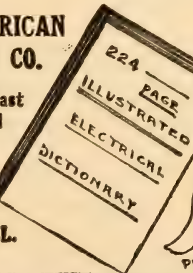

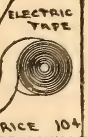

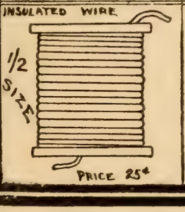

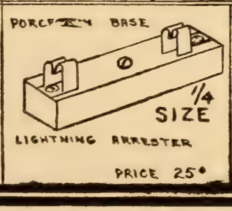

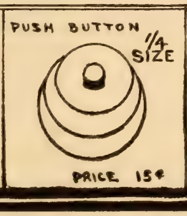

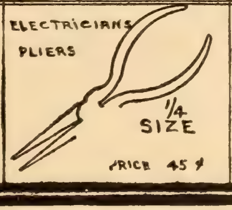

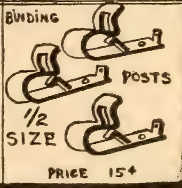

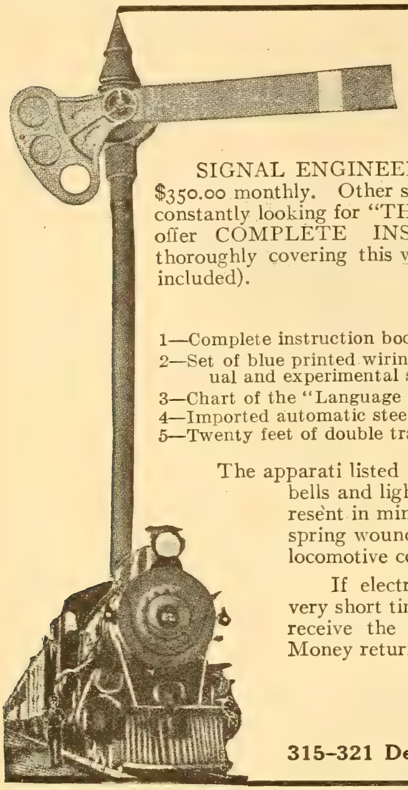

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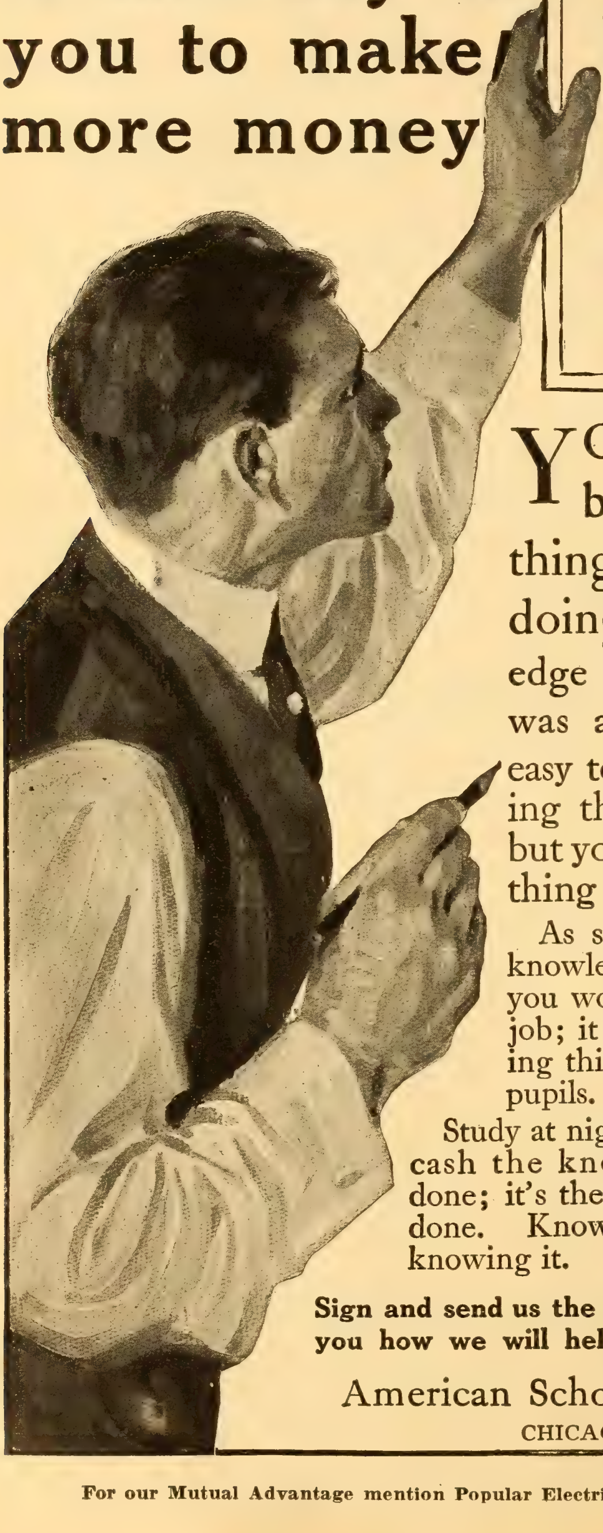

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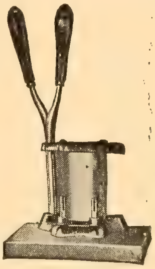
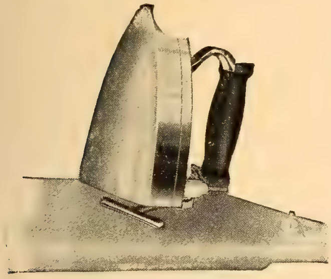


Curling Iron Heater



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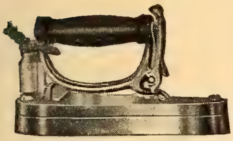
Hot Water in 45 seconds



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3-pound—detachable handle
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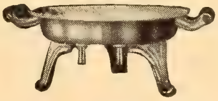
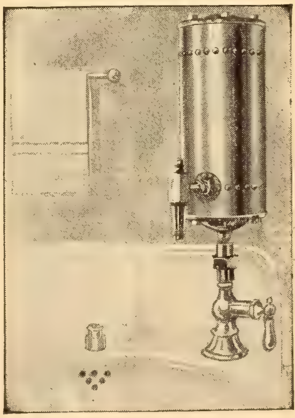


Disc Stove



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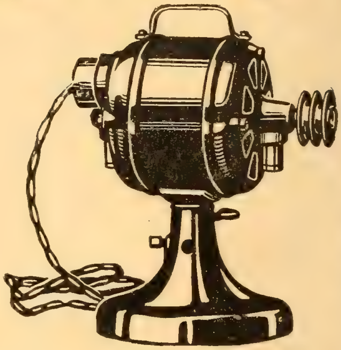
New This Christmas—A Splendid Gift For Man, Woman or Boy



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SEARCHLIGHTS FOR HUNTERS *See Page 773*

Vol. III JANUARY, 1911 No. 9

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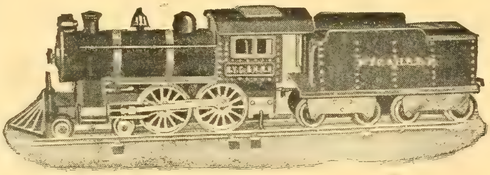

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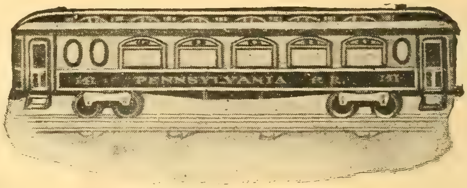

No. 18—Pullman; sheet steel construction; built with vestibules on each end; imitation leaded glass windows, two four-wheeled trucks; interior fitted with seats; beautifully decorated in colors; length, 16 in.; height from tracks, 6½ in.; weight, 2½ lbs. Each **$4.15**

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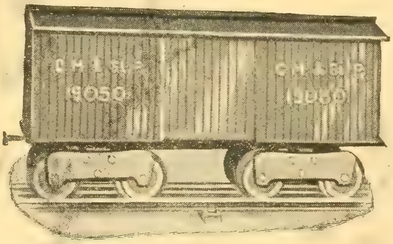

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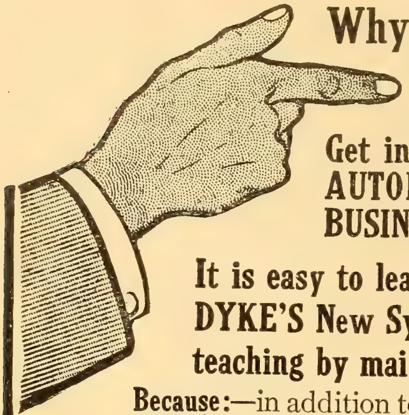

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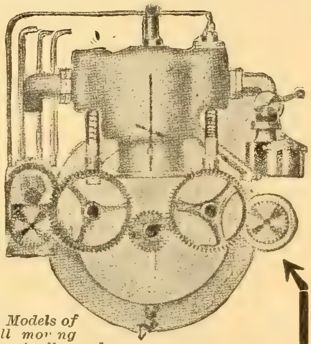

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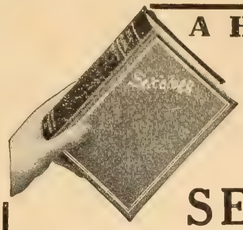

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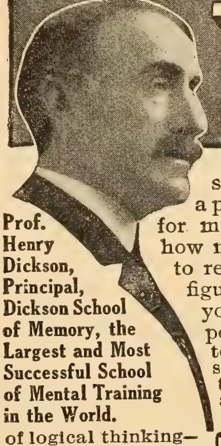

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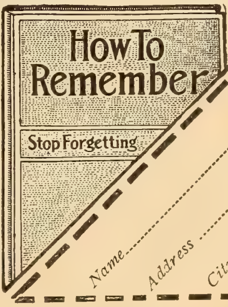

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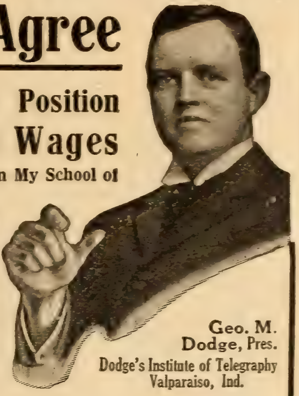

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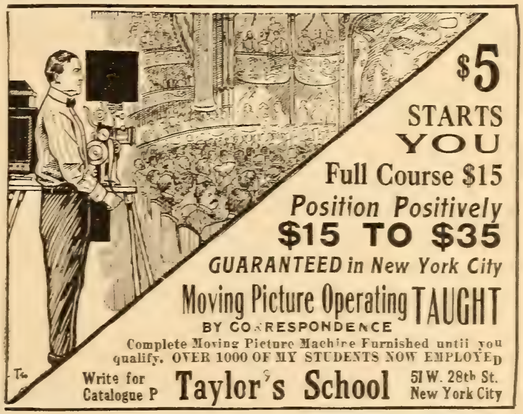

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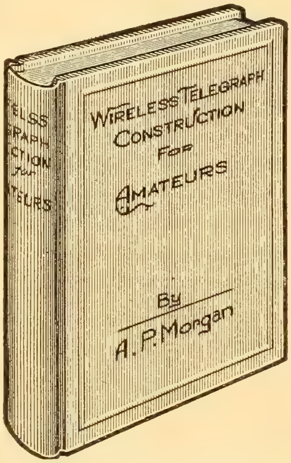
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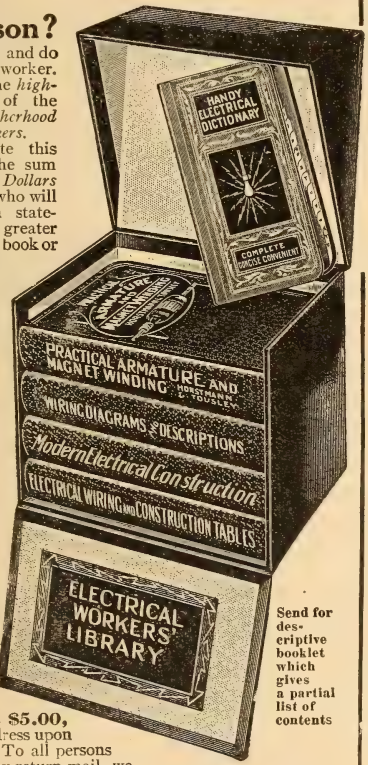
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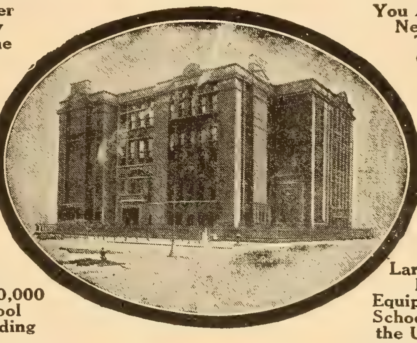

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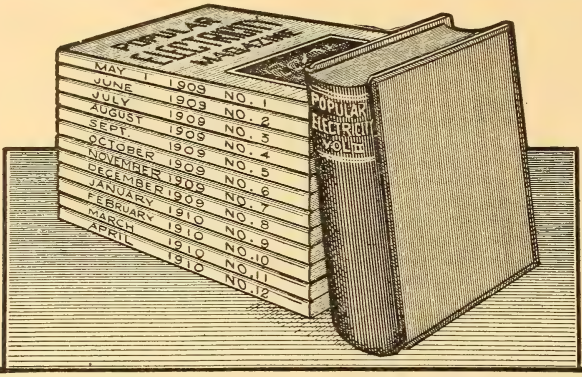

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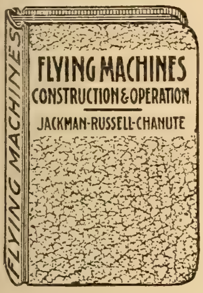

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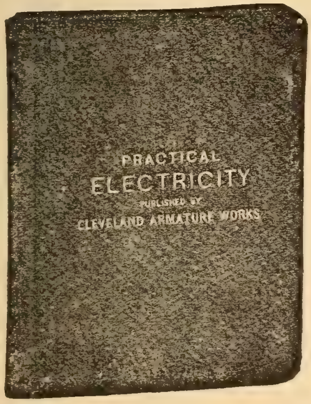

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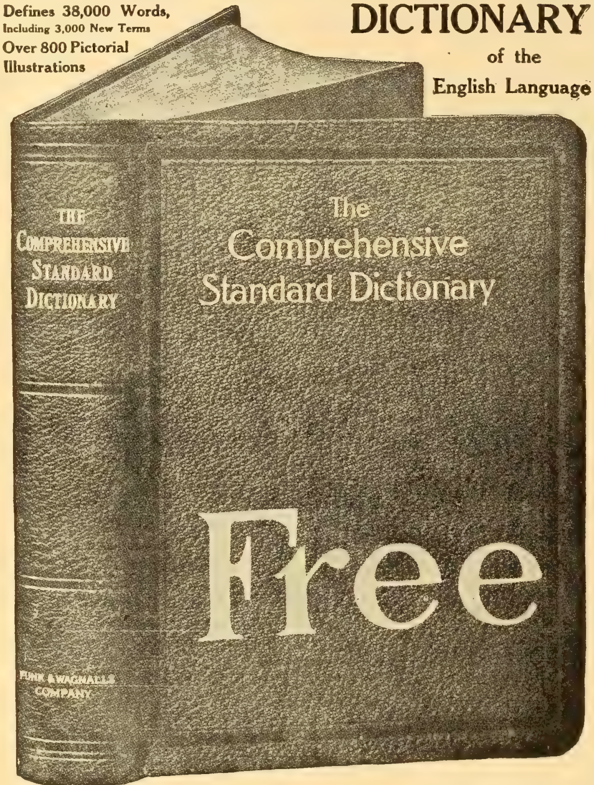

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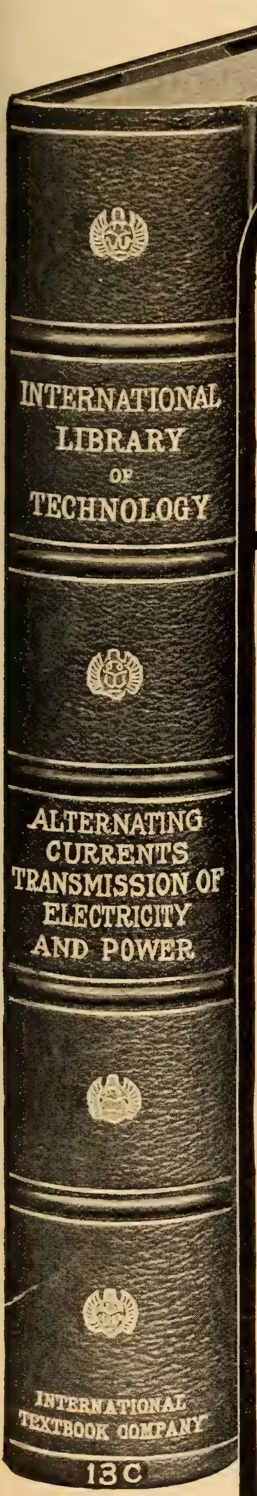

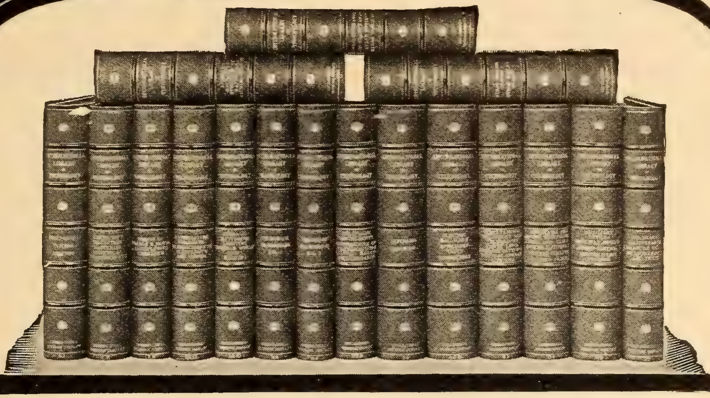

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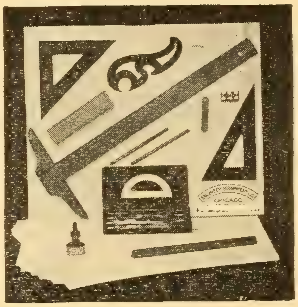

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Vol. III January, 1911 No. 9

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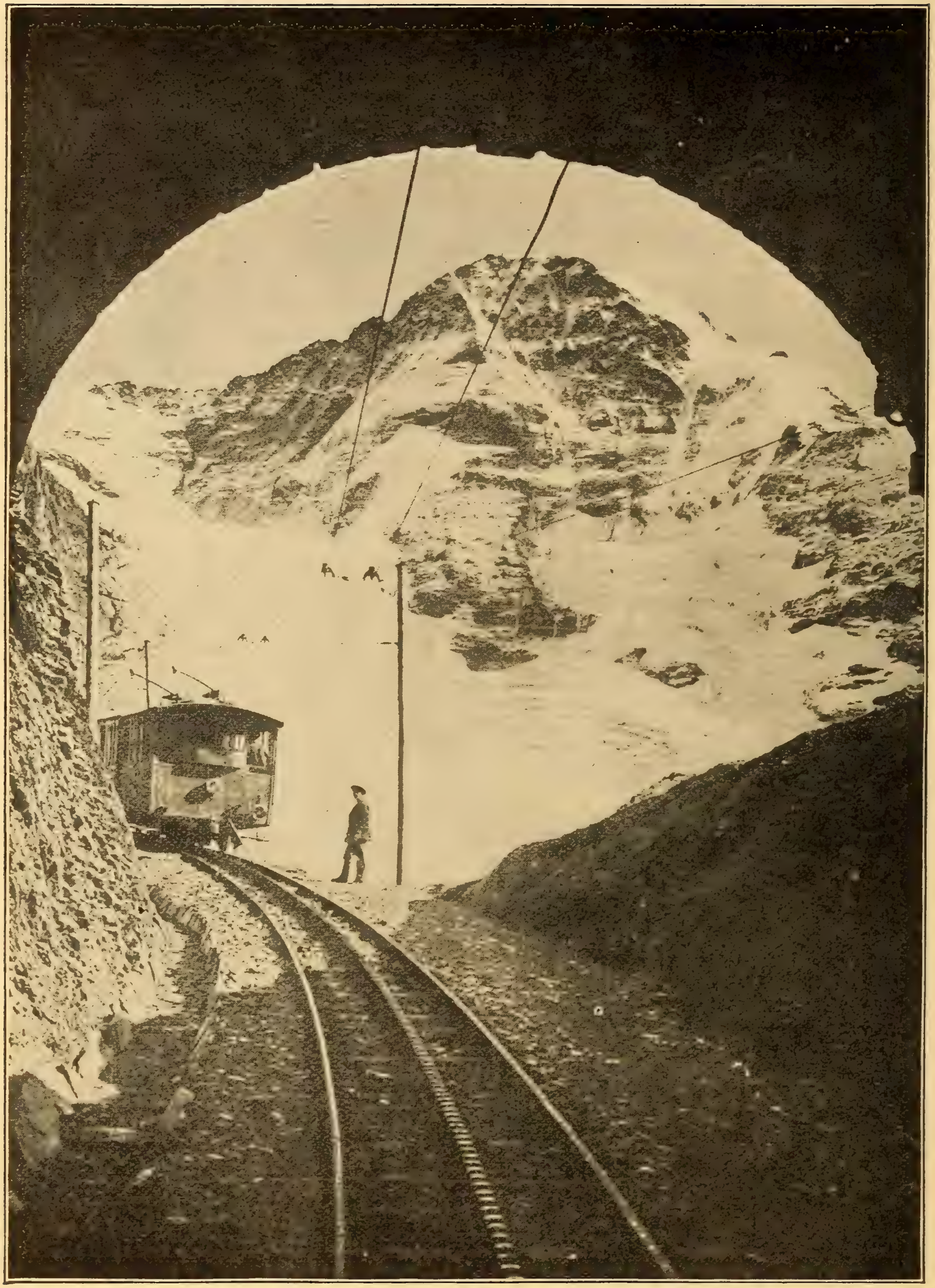

LOOKING OUT OF THE TUNNEL OF THE JUNGFRAU RAILWAY—MOENCH PEAK IN THE BACKGROUND

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In Plain English

VOL. III JANUARY 1911 No. 9

Up the Jungfrau by Trolley

By FRANK C. PERKINS

Early in the history of steam railroading Adolph Guyer Zeller designed the Jungfrau railway. At the Scheidegg he noted that the Wengernalp railway had already attained an elevation of 6,770 feet and the future Jungfrau railway ought to start, not from the valley of Lauterbrunnen, which is 2,644 feet above the sea level, but from the point at which the Wengernalp railway attains its greatest elevation, at the Kleine Scheidegg. By this plan the altitude to be overcome in order to reach the summit of the Jungfrau at an elevation of 13,671 feet, would be reduced by more than 4,000 feet. And so the Jungfraubahn was built and operated for many years as a steam road. Like most of the railroads of Switzerland, however, it came in for electrification with the advent of the "White Coal", as the electric current from the magnificent water powers of that country is familiarly called, and was one of the first electrically operated lines in the Republic. From this mountain road and from the little stations, the sites for which were literally hacked out of the side of the mountain, are to be viewed some of the most entrancing of Alpine scenes.

Before the electric mountain railway was constructed only men of sturdy frame and considerable muscular power were able to undergo the fatigue of climbing to the summits of these lofty mountains. They are now, however, accessible even to the weak without great effort or exposure. Upwards of 100,000 tourists climb the Jungfrau each year by means of this electric mountain railway, and it is estimated nearly a million tourists have taken advantage of this marvelous engineering undertaking since the road was built.

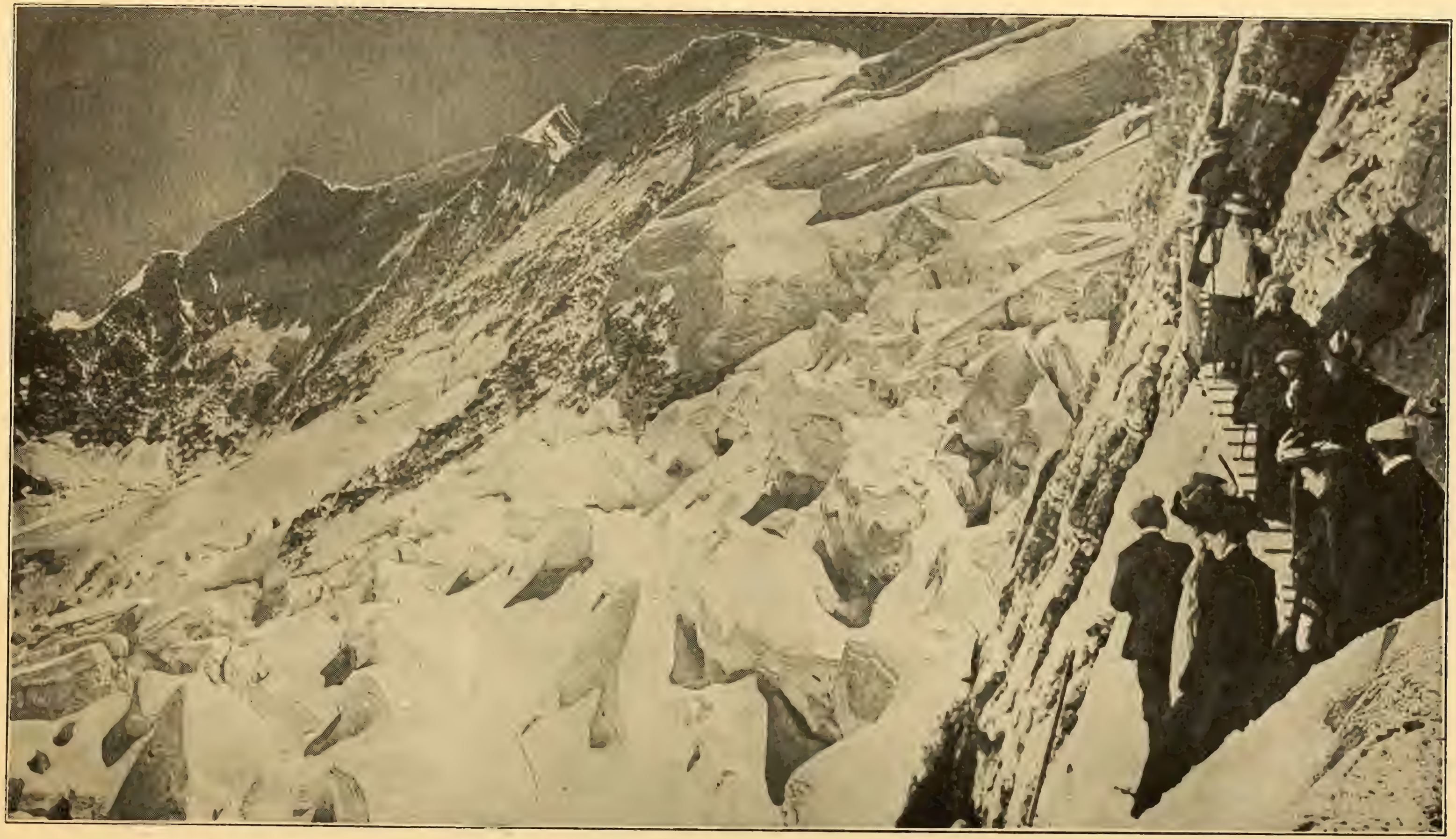
Engineer Zeller held that a route should be selected which would give a gradient of one in four, the same as that which was adopted for a majority of mountain railways at that time. This Swiss engineer planned to start from the Scheidegg and follow the pass of that name as far as the Eiger; and then to cross this mountain, as well as the Mœnch, and passing beneath the Jungfraujoch, reach the summit of the Jungfrau.

Really this route was necessarily longer than those which had been planned previously, but it was so ingeniously devised that, by the establishment of several intermediate stations on the north and south sides of the Jungfrau chain, it afforded a number of new viewpoints and constituted as it were several mountain railways, the whole forming the Jungfrau railway.

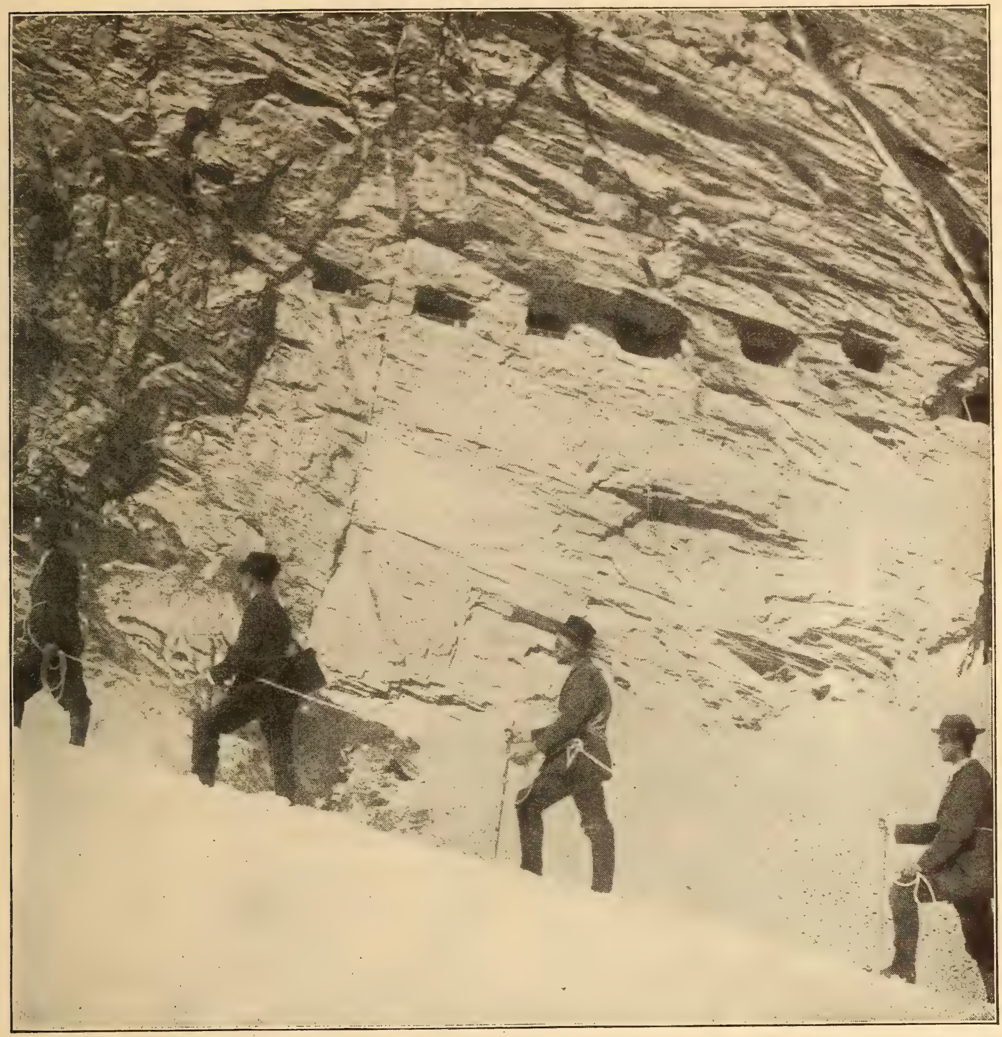
It may be stated that the distance from the Kleine Scheidegg to the Eigergletscher station is 2,187 yards, and the latter is located 7,624 feet above the level of the sea. From time to time enormous masses of ice are detached from the mountain, especially from the Geissen Glacier, the side of the Jungfrau, and fall with a crash like thunder into the deep and dark valley of Trummelten, and there gradually melting, they feed the Trummelbach, which forms the well-known waterfall near Lauterbrunnen before joining the water of the White Lutschine.

The train glides gently forward on this electric rack railway without any of the disagreeable shocks and jolts so common on mountain railways worked by steam, with no inconveniences from smoke and sulphurous fumes of steam locomotives.

The necessary current for operating the Jungfrau railway is conducted along two



SLOPING WALK WHICH STARTS FROM EISMEER STATION OF THE JUNGFRAU RAILWAY, 10,000 FEET ABOVE THE SEA



SHOWING THE JUNGFRAU RAILWAY AS IT PASSES AT ONE POINT THROUGH A TUNNEL, WITH EXCAVATED "WINDOWS" THROUGH THE ROCK WALL

copper cables from the power house at Lauterbrunnen to the Scheidegg. The track was built on the system employed by Engineer Emile Strub, of Zurich, as now applied to all the new mountain railways. The electric locomotives are fitted with all the necessary safety appliances and, whether ascending or descending, they cannot exceed a speed of 5¼ miles per hour. Should this speed be exceeded an automatic brake comes into play and stops the train. Measures have also been taken to provide for other emergencies, such as the sudden failure of the current.

One locomotive and two carriages, each seating 40 passengers make up each train. It wends its way along the pass, having on its right the valley of Lauterbrunnen and on its left that of Griendelwald. It then enters a tunnel 95 yards in length, when automatically the electric lamps in the carriages and the locomotives are lighted. But in a few moments they go out again and the sun once more pours its rays into the cars, and the glaciers and ice-covered slopes of the Eiger, the Mœnch and the Jungfrau come into view.

The Jungfrau Railway and the Weingernalp railway are not worked after October in consequence of the heavy fall of snow.

About 220 yards above the Eigergletcher station the line enters the main tunnel, which is six miles in length and measures ten feet wide and fourteen feet three inches in height. The top is semicircular in section. It is said that the rock through which the tunnel was pierced was very favorable for boring, being what is known as "hochgebrigskalk," a limestone which, though easy to bore through is yet hard and tenacious enough to make a lining of masonry unnecessary.

This is the highest tunnel in the world. From here the Eigerwand is reached in about 20 minutes, when the tunnel suddenly expands into a large hall and the train comes to a standstill. The Eigerwand station is lighted electrically and is 9,410 feet above the sea and 4,810 yards from the Scheidegg. It was the first station excavated in a mountain side in the world, and there is nothing like it elsewhere.

It may be mentioned that nowhere except on the Jungfrau railway is there a station blasted out of the interior of a mountain and yet commanding a magnificent view. Between Eigergletch and Eigerwand stations is Rotstock station, at an elevation of 8,300 feet, on a rocky plateau reached by a short lateral.

It is held that never before has a work been accomplished in climatic conditions such as prevails in these regions of eternal snow, and for many reasons the engineers of the Jungfrau railway could not profit by experience acquired in the construction of other railways. They had to invent and construct devices and appliances which have been found serviceable to those who followed them in similar undertakings.

There is provided gratuitously for the use of the passengers an exocllent telescope of 108 diameters, by which the buildings on the Rigi, Pilatus Stanserhorn, Breinzer, Rothorn and Eaulhorn may be seen, as well as the tourists around them.

There is also an electric searchlight of enormous candle-power which has a reflector 3½ feet in diameter which is used in the evening. It throws its beams far and wide and exchanges salutations with its less powerful colleagues on the Stanserhorn and other peaks. It is said that by its light a newspaper can be read in the streets of Thun, and it is clearly visible at a distance of 60 miles.

The Eismeer station is a masterpiece of constructive ingenuity, and consists of a large hall excavated, like Eigerwand station, in the "hochgebrigskalk," and pierced with several openings on the south side. The width of these apertures and of each of the pillars separating them is 20 feet, and the width of the station from the internal face of the pillar to the opposite wall is 26 feet. A large part of the underground chamber forms a comfortable room which is electrically heated and provided with a parquet floor and glass windows. The room also contains on one side the apartment of the station master, with a postoffice, which is said to be the highest in Europe, and on the other side an electric kitchen and restaurant. Neither wood nor coal is used in this kitchen, as everything is cooked by means of electricity, which is also used for heating the restaurant itself. This great electric kitchen at Eismeer station is the first of its kind to be installed in Switzerland.

A Divided Orchestra

At night there is usually little for the operators and night station agents at the smaller railroad stations to do. In former years when the commercial wire was cleared of its business they would all cut in and have a general conversation.

Since the 'Frisco Railroad has adopted the telephone for train dispatching, the night men cut in on the Western Union wire with their telephone sets and converse with each other without hindering the use of the wire for the Morse telegraph instruments, as one wire will carry both telephone and telegraph messages simultaneously.

The feature of these evening chats is selections by their orchestra. Three of the operators at widely separated stations play musical instruments, one the violin, another the guitar and the other the clarinet. Each one has prepared a paper megaphone which he places with the small end against the receiver of his telephone, adjusts his head piece and they are off. They tune up and render such selections as they have worked up together while the other operators along the line listen and occasionally join in and sing.

Sometimes the dispatcher's call puts a quick stop to their selection when he is in a hurry to find out the whereabouts of Extra 822 or Second No. 10.

In Quest of a Voice

By FLOYD HAMILTON HAZARD

PART II.

"I beg a thousand pardons," said the man, mechanically, almost without looking to see who it was he had stumbled against. "I didn't——Why! It can't be possible! Ted Van Doren! After all these years? I never knew the beat! Don't you know me, you old owl? Where in the name of sense have you kept yourself?"

Osgood had stepped back when he saw the door open and was as wide-eyed at such a greeting from an utter stranger as was Van Doren. He waited to see what his friend would do.

Suddenly Ted came to life.

He grasped the young fellow by the shoulders and shook him delightedly.

"Will Barringford, by all that's wonderful!" he ejaculated. "Why, you old skeezicks, how was I to know you all in an instant? You've grown up, you rascal! But what are you doing here? Thought you were in business down in Maryland."

"I'm the manager of The Southern Construction Company," answered Barringford. "We've only had an office here in the city for about a month and I've been so busy that I haven't had a chance to look around. I thought you located in South America."

"So did I, but I changed my mind and came back."

"Suppose you're married, and all the rest of it?"

"No, I'm living at the club. Are your father and mother here too?"

"Yes, We're living up town and you've just got to come along with me to dinner. We're expecting some old friends tonight and, by Jove, I've just found another one to make the party complete."

Ted was blessed with an inspiration.

"And you dine at seven o'clock and your name is 'Will!' You bet I'll come!" he exclaimed with a searching look into Barringford's eyes.

"Fred," he continued, smiling knowingly at Osgood, "allow me to present one of my old chums, Will Barringford. We were great cronies when he was a youngster and I was down on that job in Maryland."

"Always glad to meet any friend of Ted's, Mr. Osgood, and I hope he'll bring you up to see us soon," said Barringford, cordially, although he seemed puzzled by Van Doren's reference to the hour he had mentioned and to his first name. "I'd like to ask you to join us at dinner, but I know you will excuse me, under the circumstances. Isn't this the limit, the way we've met?"

Osgood had understood at once, when Barringford's dinner hour was mentioned and Ted had remarked upon it, that, as far as he was concerned, the puzzle was all put together.

"It certainly is most remarkable, Mr. Barringford," he replied. "I'm mighty glad, both on Ted's account and on my own account. I hope we shall become better acquainted."

The trio had, during the latter part of their conversation, moved down the corridor, taken the elevator, and were about to leave the building.

Barringford gave Ted his address and hurried away after receiving renewed assurance that the latter would not fail to present himself at the house just as soon as possible.

"I suspect that the pleasure of meeting our guests will not be all your own," had been his parting words.

"You've been deceiving me all these years, Ted, you old scoundrel," said Osgood, as they were about to separate. "I never even supposed you capable of campaigning for a lady's hand, but when you institute such a relentless search because of having taken a fancy to the voice of some unknown female, the revelation of the depths of your duplicity and absolute recklessness is appalling."

"So!" laughed Van Doren. "Well, I'm all excited about it anyhow, however it may turn out. It's evident that the lady will be there tonight, but who she will prove to be, is as much a mystery as ever. Will seems to hold the last card."

"I hope you fall head over heels in love with her, marry her, and live happily ever after," said his friend, sincerely. "It would be the best thing that could possibly happen to you. I'll be anxious to learn what comes of it, so don't fail to let me know, tomorrow. Good-night."

HE SEIZED IT EAGERLY FOR A CLOSER LOOK

Van Doren returned to his rooms to dress for the evening. He made a careful though hurried toilet and took a taxicab to Barringford's residence. His friend, Will, had evidently been watching for him, for it was he who opened the door as Ted came up the steps.

"You certainly must have hustled to have reached here so soon," he said, drawing Ted inside. "But then, you always were a hustler."

"I was impatient to learn what you meant by that remark about the 'pleasure not being all my own,'" explained Van Doren, as he removed his overcoat.

"Oh, you were, eh?" said Barringford, smiling mysteriously. "Well, step into the drawing-room while I go up stairs and tell the folks that you've arrived. That'll be the quickest way to settle it.

"Afterward you can explain to me why you were so glad to remember that my name is 'Will' and that we were to dine at seven o'clock," he added, from the stairway.

Van Doren entered the cozy drawing-room and seated himself before the open fire. He glanced about the room, noting with interest some of the furnishings with which he had formerly been familiar. A book of travel, on the table, close at hand, caught his eye, and he idly picked it up to glance at the title page. Inside was a photograph and he seized it eagerly for a closer look.

"Lillian! Oh, Lillian!" he murmured, devouring it with eager gaze. "Oh, you splendid, splendid girl!"

The portrait was evidently a recent one and he sighed as he studied the features which were still so dear to him, in their greater maturity.

Thoughts of the past and of what might have been, possessed him.

He remembered the time when he had first gone south; how he had had an introduction to the influential Mr. Burkwell; and how he had been helped by him in getting that work started. He recalled his first meeting with Lillian Burkwell, in her father's house; and how completely she had captivated him. He had loved her from that first moment and had not hesitated to display it.

He smiled, sadly, as he recollected how all of her old admirers had thirsted for his heart's blood; and how earnestly he had endeavored to cut them all out.

Then had come lack of progress in his suit. It had almost driven him to distraction. They had been such good friends, but she was soon to go abroad to study how to be famous, and would listen to nothing which was likely to interfere with her plans.

He shivered as he thought again of the calm firmness with which his proposal had been rejected; and of the long, weary years of strenuous effort with which he had attempted to repair his broken spirit and to drive all thoughts of her from his mind.

How many?

Eight.

Oh well, it might as well have been a thousand. Time was only an eternity in a matter as deep as that.

So completely was he absorbed in retrospection, that he had forgotten his surroundings. For this reason, he was unfortunate enough to miss the charming pantomine, that was being enacted in the mirror which he faced.

It reflected the hangings that covered the entrance to the room, and the fortunate one who had happened to be gazing into it at that moment, would have seen them parted noiselessly by a woman who was dressed in a clinging evening gown of soft black lace.

She stood there, silently and duskily beautiful, scarcely breathing, and with a quizzical smile hovering around the corners of her mouth.

Then, catching sight of the photograph he was holding, she blew a kiss to the lonely man.

"How dare you look at my portrait, sir, and turn your back upon the original?" she said, reprovingly, as she held out both her hands to him, and advanced into the room.

Van Doren sprang to his feet, dropping the picture like a guilty child as he heard the voice for which he had been searching, and turned toward her. To him, it seemed as though the portrait had come to life.

"Why, Lillian!" he stammered, scarce believing, and groping for her outstretched hands while his eyes searched hers. "You—that is, I mean I—you startled—I mean I was so startled——"

"Why of course you were, you silly boy," she said, lightly. "I wanted to surprise you."

Her bright look wavered under his direct gaze.

"I thought I had lost you forever," he murmured, huskily.

His hands tightened on her own and she made as if to withdraw them.

"Tell me, quick," he whispered. "Am I free to ask you a question *again*?"

"Oh, not now! Not now!" she answered timidly. "Wait."

"No!" said Van Doren, decisively. "I've waited much too long already. Tell me. Is there still no place in your heart for me, little one?"

"There is a place in my heart for no one else, Ted," she answered tremulously. "There never has been; but it has taken me, oh! such a long, long time to realize it."

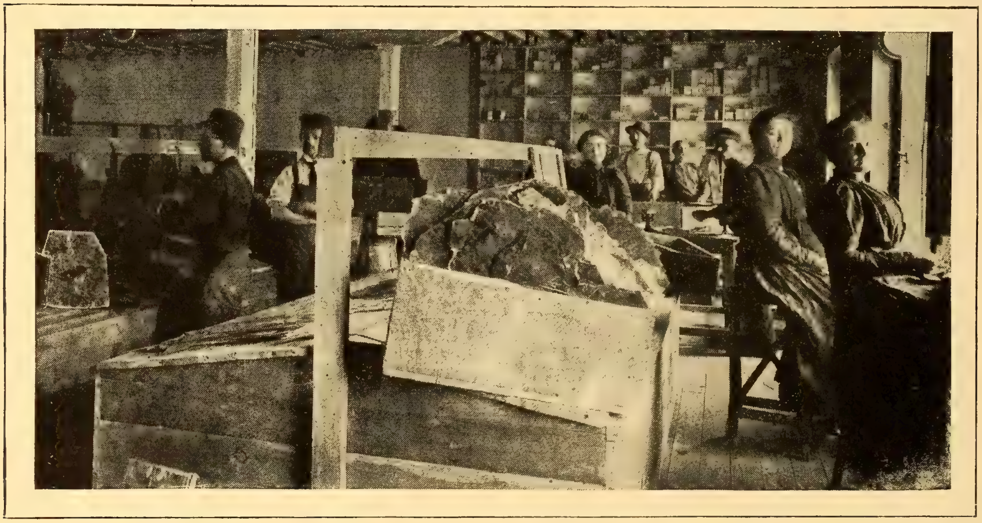
It was seven o'clock, and, considering this fact, the house was strangely silent.

(THE END)

The Story of Mica

By ORLO A. FOOTE, JR.

Did you ever stop to think what a wonderful product mica is, and what an important part it plays in the electrical field? Mica is the prime factor of electrical insulation and is used throughout the civilized world. There are but few of the many electrical appliances and machines that do not depend directly or indirectly upon mica in one form or another for their very existence. Stop and think what the results would be if it were possible for one man, like the magicians of old, to utter a few magic words and cause all the mica in use to-day to disappear. The outcome would be a badly crippled world without electric light or power. The mammoth generators you have seen humming busily away in the great power houses would commit suicide by burning out their own delicate anatomy, fast speeding electric trains and street cars would come to a standstill and remain lifeless, ponderous electric cranes carrying their tons and tons of heavy burden would lose their power and drop their cargoes to the ground.



THE MICA IS CAREFULLY SORTED AND SPLIT INTO VERY THIN SHEETS

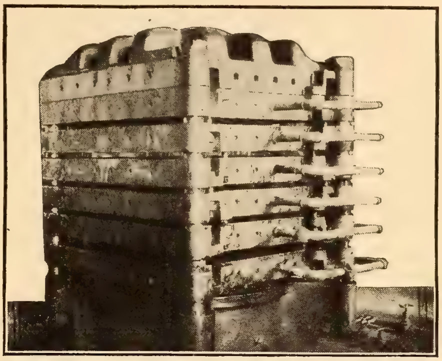
No doubt your first actual contact with mica was in the doors of the old base-burner or gas stove at home. Your father probably told you it was isinglass, and if you were curious enough to consult the dictionary you would have found the definition to be "A substance made from the air-bladders of certain fish." Queer, wasn't it, to think that the delicate membrane of a fish could stand the heat given out by the glowing bed of coals in the stove. You no doubt were suspicious, and your suspicion was well grounded as that crackly material was not isinglass but mica, just as it comes from the mine, for mica is mined just as coal and iron.

Mica, like diamonds, is found only in a very few and widely separated parts of the globe. We will deal in this article, however, with only the first grade mica that is used in the electrical field. The first and most important is a soft white mica mined high up among the barren hillsides of far-away India. The second is a dark brown or amber mica found in Canada, principally in British Columbia. The third, a hard and more brittle product, is mined here in our own country, the largest deposits of which are found in the Carolinas and Montana. Vermont also furnishes some of the mica used in this country.

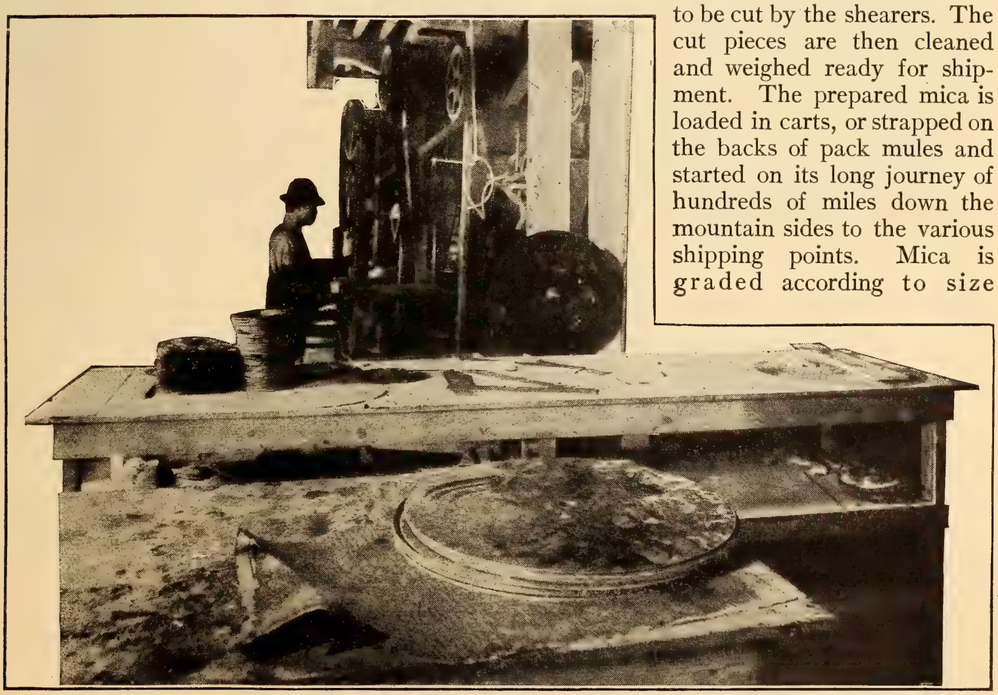
Mica or muscovite is an anhydrous silicate of calcium and aluminum, and is found at depths varying from two to 200 feet below the earth's surface, where it was crystallized ages ago under very high pressure and heat. Mica is found in pockets, in a homogeneous, laminated mass and is easily split along its axis. Expert mica workers can split mica into leaves as thin as five ten-thousandths of an inch.

Mica however, unlike most minerals, cannot be located by the surrounding geological formation, and owing to this, many mica claims have cost more to develop than the mica produced could be sold for. After the vein or pocket is located the only engineering skill required is for the proper drainage of the mine and the economical removal of earth and rock.

You have no doubt seen workmen removing old asphalt pavement from city streets, by tearing it up in large slabs with their picks, and it is in just this way that mica is torn from its native bed, with drill and hammer, although in recent years electric tools have been installed in some of the mines. After the mica is torn from the vein it is carried to the surface in large baskets, and on reaching the surface it is thoroughly cleaned to remove all traces of clay and shale which cling to it. The crude product is then roughly trimmed and sorted into different grades according to size and quality, and passed on to the mica workers who split it up into pieces varying from one-sixteenth to one-eighth of an inch in thickness. Each piece is then marked the size it is to be cut by the shearers. The cut pieces are then cleaned and weighed ready for shipment. The prepared mica is loaded in carts, or strapped on the backs of pack mules and started on its long journey of hundreds of miles down the mountain sides to the various shipping points. Mica is graded according to size



THE CEMENTED MICA SHEETS ARE BAKED FOR HOURS IN A HUGE STEEL PRESS



SAWING UP THE MICA INTO STANDARD SHEETS. THE CIRCULAR SHEETS IN THE FOREGROUND ARE FOR STATIC MACHINES.

and not quality, as is the general opinion, the quality is designated by the name, thus: India quality for mica produced in India, domestic for mica mined in our own country, and amber for mica found in Canada. The grades of crude mica are, A-1, 1, 2, 3, 4 and 5. A-1 being the largest and 5 the smallest. This grading applies to mica of any quality.

Owing to the high cost of carting mica to railways and shipping points and the increased cost of transportation, the extreme high prices asked for mica almost prohibited its use, until some years ago, when there was put on the market a form of re-constructed mica called "Micabond." As this re-constructed mica was adaptable to so many forms of insulation, and as the price was within the reach of all desiring a good product, it met with immediate success. We will give a brief account of the processes in manufacturing micabond.

As soon as the crude mica is received at the factory it is put through what is called an inductive tester, an instrument which records all traces of iron that may be in the mica. Mica showing the slightest trace of iron is discarded, as mica of this sort cannot be used for insulating purposes. Those pieces free from iron are sorted and split into very thin scales and sent to the assembling room, where they are re-assembled into large sheets with an insulating bond or cement of very high insulating properties, which absolutely excludes all moisture and makes the finished product impervious to water. After the crude sheets have been formed by alternate layers of mica and cement, they are put into large steel presses and baked for many hours under high pressure and temperature. This baking and pressing process forms the sheets into a solid, homogeneous mass of such solidity as to emit a metallic ring when struck. The sheets of micabond are then air cured for 24 hours, after which they are sent to the milling and saw room where they are milled down to the proper thickness and cut into standard sheets 18 by 36 inches.

PACKING ROOM. ON THE TABLE AT THE RIGHT ARE MICABOND COMMUTATOR SEGMENTS AND RINGS. THE ROLLS ON THE SCALES ARE MICABOND CLOTH.

Micabond is made in four qualities. The first is 102 plate and is built up of soft white India mica, and will stand a breakdown test of 1,012 volts to one-thousandth of an inch of thickness. This style of plate is used in making commutator segments, washers and other flat work. The second style of 101 plate is also built up of soft white India, but is unbaked and can be molded or formed to any shape, as it becomes flexible under heat. Owing to its ability to be moulded, this plate is used for commutator rings, tubes, armature troughs, magnet spools and other work where special shapes are required. The third quality of micabond is 104 plate and is built up of only soft Canadian amber mica, and is used almost entirely for commutator segments as it wears down smoothly with the copper bars of the commutators. All of the above-mentioned micabond plates can be milled, stamped, sawed and drilled and can be made in thicknesses to resist any voltage, as the breakdown test is 1,012 volts per one-thousandth inch of thickness.

Last but by no means least, is a style of plate called flexible micabond. This material is naturally flexible and will remain so for an indefinite length of time. Flexible micabond is built up of India mica split exceedingly thin and will stand a breakdown test of 750 volts per one-thousandth inch. This plate is used largely in insulating transformers, spark coils and armature slots.

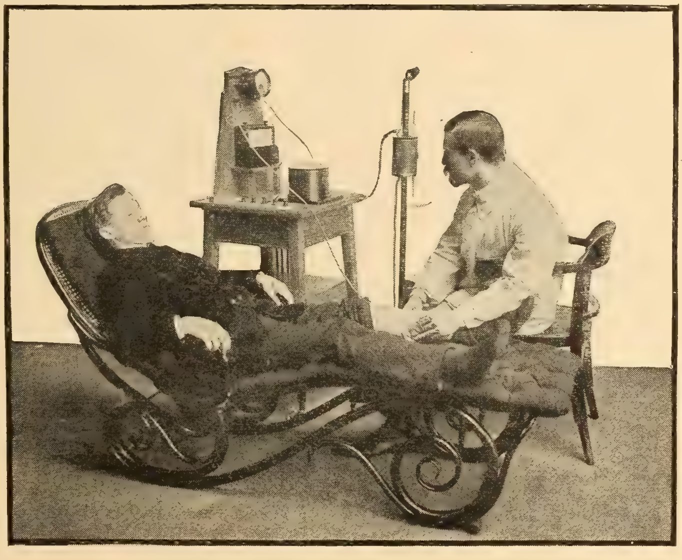
Making Heat Penetrate the Bones

A new way of applying electrically generated heat as a therapeutic agent has been devised by two German scientists, Gebbert and Schall. It provides for the application of heat locally and to a greater depth than can be reached by any superficial means, the principle involved being that of the high frequency current which, as is generally known, can be applied with safety to the human body. The treatment is used in the case of rheumatism, neuralgia, etc., and is even useful in case of diseases of the heart and lungs.

The apparatus consists of two copper electrodes to be applied to the parts to be treated. These electrodes are connected to a source of high frequency current, the necessary meters and indicating devices being also connected in the circuit.

A very comfortable feeling is provided by the electric heat traversing the part of the body under treatment, and as the heat is produced within the tissue it is retained for a long time after the treatment, particularly within the bones which are said to cool down very slowly.

The electric heat penetration treatment varies from five to ten minutes according to the parts to be treated, the shape of the electrodes and the current intensity used. The high frequency of current employed is similar to that used in wireless telegraphy and it is claimed affords means of applying electrical treatment to the body without any risk of injury.

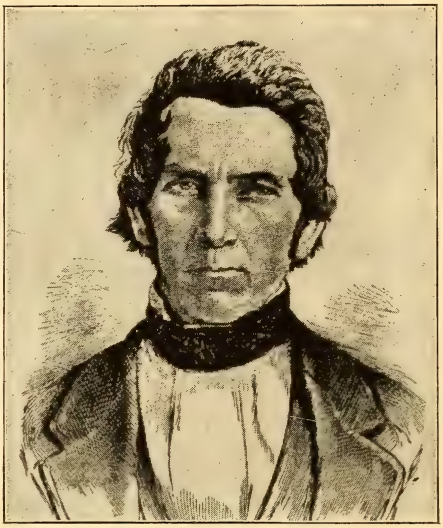


MAKING HEAT PENETRATE THE BONES

It has not been possible heretofore by artificial means to increase the temperature of those parts of the body which are affected by disease, thus assisting nature in its work, as the effects were merely superficial. The heat did not penetrate to the parts desired, but resulted in a general heating of the whole body. The new German process using high frequency current allows any parts of the body to be heated to any temperature desired.

An Appreciation of Thomas Davenport[1]

By T. COMMERFORD MARTIN



THOMAS DAVENPORT

My special duty and honor today is to emphasize, in this region where he lived and dreamed and suffered and wrought, the name of Thomas Davenport of Brandon, Vermont, the first American patentee and builder of the electric motor; the first man in all time to apply electric power to the operation of railways; the first man in the world to hitch together those two tremendous forces, electricity and the printing press.

Thomas Davenport was born at Williamstown, Orange County, Vermont, a descendant in direct line of the Davenport family conspicuous in the early annals of the New Haven Colony. Thomas was only ten when his father died, only fourteen when he was apprenticed to the blacksmith trade. All the formal education that Davenport got was for six weeks a year, for a briefly indefinite number of years, in a common district school house in a remote mountain town. But he did get hold of some fragmentary portions of a scientific book, and as he blew the bellows, so with it he fed and fanned the fires of his intellect. Meanwhile he lived at Forestdale, then a center for a little iron industry, the blast furnace being located there doubtless because of the availability of charcoal. He was a slender, thoughtful lad, and never appears to have been in very robust health. The whole drift of his thought is indicated by the fact of having made the acquaintance of another clever young fellow named Orange T. Smalley, wagon builder and wheelwright, he formed the ambitious plan of going from place to place to deliver experimental scientific lectures. The question of apparatus came up, and very naturally with the discussion came the wonderful "galvanic magnet" of Joseph Henry in operation at the Penfield Iron Works at Crown Point, only 20 miles away, for sifting magnetic iron ore. This magnet, it was rumored, would hold up a blacksmith's anvil, like Mahomet's Coffin, between heaven and earth, and Davenport determined to see it and get one. During the intervening years the peripatetic lecture scheme seems to have been wholly abandoned, a reason being found in his settlement at Brandon in 1823 as an independent working blacksmith and his marriage in 1827 to Emily Goss, of that town, a beautiful girl of seventeen, granddaughter of the famous American traveler, Jonathan Carver. Under such stimulus he worked hard at his trade, prospered thereby and built himself a brick house.

He was altogether in a fair way to accumulate a comfortable property, for he was intelligent, sober, upright, diligent; but electromagnetism was his undoing. We might almost call it "malicious electro-magnetism." Going to the Penfield works in 1833 with $18 to buy iron for his business, he spent the money there instead in buying an electromagnet and batteries. The iron was needed at the shop, but how much more he needed that magnet!

As he handled the primitive little equipment, "Like a flash," he says, "the thought occurred to me that here was an available power which was within the reach of man." Yes, it was there, and his was the superb divination of genius to detect it. He was like another Saul hunting down his father's asses and finding a kingdom.

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[1] Abstract of an address read at Brandon, Vt., September 28, 1910, on the occasion of putting up a bronze tablet in commemoration of Davenport.

Certainly from the materialistic point of view, that magnet was a curse, like those legendary possessions inflicting injury upon their fatuous owners. Never again was Davenport to know peace of mind. Never again were his family to enjoy a home of comfort. Indeed, they were called upon to share his sacrifices. It was supposed in those days that wire needed silk for insulation. His brave young wife took her silk wedding gown, cut it into narrow strips, and with them were wound the coils of the second motor, which in October, 1835, he showed in successful operation upon the judges' bench in the courtroom at Troy, New York. Wifely devotion could hardly go much farther. Later on Davenport learned that silk was not so essential but that cotton wound wire would do.

UNVEILING THOMAS DAVENPORT TABLET, FORESTDALE, VT. BY VERMONT ELECTRICAL ASS'N, SEPT. 28, 1910.

Of course the inventor had friends in all his struggles, though many of them, including his shrewd and kindly father-in-law, urged him to quit and settle down to the commonplaces of life. Others, like the talented Smalley, worked with him awhile, and then drew off. One of his strongest supporters was Ransom Cook, a furniture manufacturer of Saratoga Springs, who gave Davenport for some years the aid of his purse, and the assistance of his unusual mechanical ability. From Professor Turner, of Middlebury College; from President Eaton of the Rensselaer Polytechnic Institute; from General Van Rensselaer, of Troy; from Professor Henry, of Princeton, he received generous and substantial help.

Going sanguinely to Washington in 1835 to secure a patent on his first motor—he had already built about a dozen—he was obliged to return home penniless, his errand unaccomplished, like Mark Twain's politician who drove to the National Capital in a four-in-hand to get his appointment, and then after months of weary waiting slunk away on foot—without it. Time and again we find Davenport playing the part of a showman, glad to pick up a few casual dollars in that way; but at no time getting out of financial difficulties or planting his feet firmly on the rock of commercial success. He remained an inventor to the end of his brief life in 1851.

And now for a brief glance at what Davenport actually did. When Davenport came on the scene, Faraday and Henry had already done their great work; and the principles of both the electric generator and the electric motor had been clearly perceived and enunciated. Yet there were no real motors before Davenport's time, and had the dynamo then been known his work would have been carried to instant fruition. In Davenport's day they had not learned to convert either the energy of steam or that of the waterfalls into electric current; and thus all the electrical arts lingered and languished, except telegraphy. The reason is simple. Beginning at the same time as Davenport, and deriving, it would seem, both suggestion and inspiration from his apparatus, Morse was able to make practical the art of communicating intelligence because it took such a small amount of energy to transmit signals by dots and dashes over a wire. But when Davenport told the great Joseph Henry that he proposed to build his motors up to one horsepower, the cautious philosopher warned him to "go slow," and hinted that electricity could not compete with steam.

In Europe, Jacopi, like Davenport, as early as 1834, had obtained rotary motion from electro-magnets, and in 1838, at the expense of Emperor Nicholas, he propelled a boat on the Neva with his motor energized from batteries. Here again the demonstration failed and ceased for lack of an economical source of current. There is close rivalry as to dates between the physician in Russia and the blacksmith in Vermont, but both at least encountered the same fatal obstacle, the lack of cheap current. So far, moreover, electricity has made no triumphal entry into navigation, but at a time when his native State had not a single mile of steam railroad, Davenport built his model electric road and asserted that that was the best way to do it.

In July, 1834, Davenport had built his first motor with two stationary electro-magnets and two revolving, the changes of polarity in the two sets causing attraction and repulsion, with consequent rotation, thus, as he says, "producing a constant revolution of the wheel." We have not advanced a bit since that hour nor can we, for as Davenport wrote at the time of securing his patent the principle of his invention "was the production of rotary motion by repeated changes of magnetic poles." If anyone can improve on the method or the description of it he is entitled to a high place in history. That patent, granted February 25, 1837, first of its kind in America, was broad as a Papal Bull, and embodied this claim: "The discovery here claimed and desired to be secured by letters patent consists in applying magnetic and electro-magnetic power, as a moving principle for machinery in the manner above described, or in any other substantially the same in principle."

The crude motor of 1834 was soon followed up by an improved form in 1835 and by many others as the years went by. The motor of 1835 is interesting as being the earliest known instance of the application of the modern commutator. An elastic contact-spring or brush pressed against metallic segments fixed upon a revolving shaft, so that the shifting polarity of the magnets was maintained as current was received from the battery. In 1836 and 1837 motors and models were built illustrative of electric railway work, and the motor was shown to the public running on a miniature circular track 24 inches in diameter. The battery was not carried by the car but was placed in a tray at the center of the circle and contact was made through mercury cups. This device embodies, therefore, remotely but inevitably, the idea of a central station source of supply. Later inventors still carried their batteries on the car, just as a storage battery car does today. Moreover, the magnetic field magnets and those of the armature were connected in parallel, so that at that early date we have a shunt wound motor, each core being wound twice with 24 convolutions of No. 16 wire, connected in parallel. Another striking fact was that as the model itself showed, the circular track was used as the return circuit, just as every trolley car uses it today. In 1836 his motor model filed at the Patent Office in Washington was destroyed by fire as well as 7,000 others; just as another Davenport motor at the Rensselaer Institute, Troy, was destroyed in 1862 by fire. This kind of fatality pursued much of his work. In 1893, the present speaker exhibited at the Chicago Columbian Exposition one of these Davenport railways where it received an award. Its exhibit was requested for the American section of the Paris Exhibition of 1900, and it was shipped early in that year with the Government exhibits on the steamer "Panillac". Violent storms swept the Atlantic, and the steamer has never been seen since. In like manner disappeared the first dynamo ever placed on a ship. Mr. Edison equipped the Arctic exploring ship "Jeannette" with a little dynamo arranged so that if necessary it could be driven by manual power "to help keep the men warm." The ill-fated "Jeannette" like the "Pauillac" now lies in ocean depths awaiting some cataclysm thousands of years hence, when men may see again these relics of their remote ancestors, preserved in the museum of Eternity.

Nothing daunted by fire, Davenport made a third trip to Washington in 1837 and secured his memorable patent, first of a long line in which the inventive genius of our people has shone forth so strikingly. During the same year, Davenport and his friend Cook established themselves in New York with a laboratory and shop, and gave exhibitions of their apparatus to crowds of visitors, including Morse, already busy on his telegraph, and Page, who fourteen years later operated a battery driven locomotive of twelve horsepower on the Washington and Baltimore Railroad. In March, 1837, the partners, to raise funds for their work, organized the Electro-Magnetic Association with its stock divided into shares. So far as can be ascertained this was the first electric stock company in America, first of several thousands now representing a total capitalization of ten billions of dollars in bonds and stock and which are earning over $800,000,000 annually.

The manager of the financial transactions of the partners was not, however, particularly honest, and it required a chancery suit to secure an accounting, as he turned in only $1,700 out of $12,000 received. This disgusted Cook and led to his withdrawal from the enterprise.

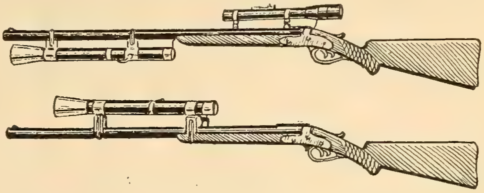
As a piece of misfortune the incident was matched by another later, about 1840, when a gentleman in Ohio proposed to join Davenport and gave him $3,000 in Ohio bank notes for an interest. Davenport had spent just $10 when he learned that the bank had broken, and that the money was worth nothing.

Davenport was not only the first man to drive a printing press by electric motor but he was the editor and publisher of the first electrical journal in the world. In 1859 he gives details with regard to the operation of a rotary printing press with a motor weighing less than 100 pounds. In January, 1840, he began in New York City the publication of a journal which he called *The Electro-Magnet and Mechanical Intelligencer*, which was not only devoted to electricity but was printed by electrical energy. The paper seems to have gone prematurely to its death, but only a few months later, on July 4th, Davenport came out with another journal which he called *The Magnet*. This had a real live editor, salary unknown, but it does not appear to have had any longer life than its predecessors.

These then are in brief the reasons why we electricians honor Davenport and revere his memory. These are the reasons why his native state and his country should be proud of him. These are the reasons why struggling against adversity, dying in poverty, and long obscured by forgetfulness, this modest simple son of Vermont stands forth as conspicuous as one of her granite mountains among the immortals who for the benefit of their fellowmen have tamed and utilized the lightnings of the Almighty.

Flashlights for Hunters

Not content with using portable lamps for lighting their way through the forests on their hunting trips, some sportsmen have learned the advantage of having an electric searchlight attached to the barrel of the gun so as to locate the intended prey in the dark. The illustration on the front cover gives a conception of the advantage of the arrangement. A lamp attachment made for this purpose by a firm in Cassell (Germany) is reported as having done excellent service in locating deer at distances of from 75 to 200 feet. Some hunters prefer it attached below the barrel, in which case a telescopic sight can be used with it; others like it mounted high above the ordinary sight. On long jaunts the hunter carries an extra pair of dry batteries and an extra lamp with him as a reserve.



METHOD OF ATTACHING THE SEARCHLIGHT

Burglars Fear the Light

Shakespeare has Macbeth and Lady Macbeth kill King Duncan under the cover of darkness. Now as then, evil deeds are committed in dark places. Police authorities assert that nine-tenths of the crimes, especially in suburban districts, take place at night in unlighted or poorly lighted streets. The electric light is the criminal's foe. Such lights in the business districts give shoppers a feeling of security obtainable in no other way. Electric lights in the home are the best protection against burglars. One turn of a switch, a burst of light, and the boldest burglar in the land is ready to beat a hasty retreat. Light, too, is a safer weapon than a revolver, which in nervous hands is liable to injure an innocent party. What is called "burglar alarm matting" obtainable at electrical supply houses may be connected in a circuit so as to close a switch and flood the porch with light and ring a bell when Mr. Burglar stands on the mat trying to pick the lock and gain admission.

Talking Between Chicago and New York

By R. M. WINANS

The miracles of yesterday are the commonplaces of today. That which sets the crowd huzzaing at its appearance is soon quietly relegated to its appropriate corner in the world's vast workroom. Man admires and wonders readily and ceases to admire and wonder just as readily.

It is but a few years since the idea of an actual conversation between one party in Chicago and another in New York would have been flouted as lunacy—still fewer since the idea, seriously and scientifically propounded, was rejected as impracticable. Today, when that idea is a reality—"now none so poor as do it reverence!" Yet, could anything be more subversive of former conceptions of space and time than for Smith in Chicago simply to take the receiver off his telephone, inform the operator that he wants to talk to Brown in New York and in a minute or two be in communication—actual voice to voice communication—with Brown who is geographically about one thousand miles away?

Between Chicago and New York six lines are available for use. With these facilities over 1,600 conversations per month were held last year.

Let us see what happens when you tell the operator who responds to your call that you wish to talk to New York. You find yourself immediately connected with the long distance "recording operator" to whom you say, perhaps, you wish to talk to Mr. Robinson, of Brown, Jones and Robinson at New York, and give her your name. You are then informed the "toll operator" will call you and you hang up your receiver. The "recording operator" while talking to you has made out a ticket showing the facts to a "directory operator" who has the telephone directories of all the larger cities in front of her and who fills in Mr. Robinson's exchange telephone number. The ticket is now placed in a pneumatic tube or in a mechanical carrier and passes directly to the line operator in front of the toll or long distance board from which the wires run to New York. This operator then makes connection through a distance trunk operator with your line but does not ring your bell. This is done to keep anyone else from calling you.

The toll operator then calls New York and has the answering operator connect to Robinson's line. His bell is rung and he is informed "Chicago" wants him. When he responds, the toll operator at the long distance Chicago board rings your bell and your conversation commences.

The information ticket is then placed in a calculagraph, a time-recording machine, and stamped with the exact time the conversation starts. On completion of your conversation you hang up your receiver and the electric signal in front of the operator shows that you have done so. Making sure the conversation is finished the operator stamps the ticket a second time, indicating the close of the conversation.

Automatic signals are then given for the disconnection of both your line and Robinson's line.

During the busy time of the day, when there are more calls than wires, the service is supplemented by the use of the telegraph. At the elbow of the long distance telephone operator sits a telegraph operator who arranges for the connection of the parties to the next conversation ,using for this telegraph service the telephone wire, without interrupting the talk going over it.

Telephone communication between Chicago and New York is frequently established in less than one minute—this measuring the time from the giving of the order to the actual commencement of the conversation. This, of course, is hardly possible during the busy hours when many calls for service accumulate. For the demands for service between Chicago and New York limit the number of wires that can be provided commercially. At present there are two direct talking circuits between the two cities and four others which may be connected through Pittsburg. These are kept constantly in use during those hours in which the "load" is heavy.

Boston may be the hub of the universe, but Chicago has become the hub of the telephone system.

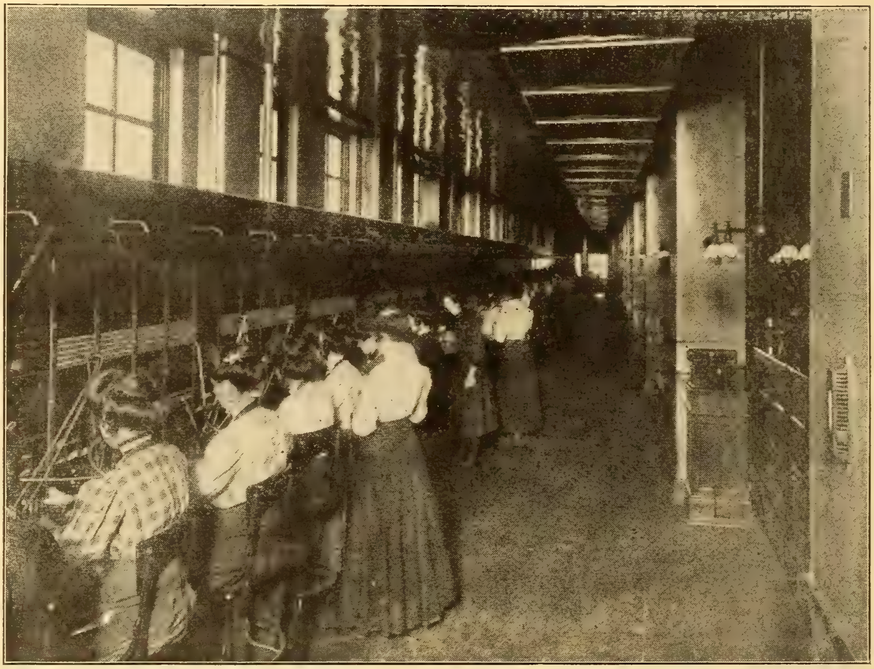
Do you ever realize that as you sit at your desk in your office in Chicago you can by simply reaching out your hand talk to any one of probably 20,000,000 people? That all the exertion necessary on your part is that required in giving the long distance operator the name and location of the person you wish?

From Chicago the extremes of distance which may be covered by telephone may be represented in the East by points in New England, in the north by the territory north of Duluth and in the south by New Orleans. On the west extensions now being made will include Denver. In all the cities and towns embraced in this area, the associated Bell companies have telephone exchanges established and toll lines radiating from them which may connect to the long distance lines, thus making available nearly 6,000,000 telephones and a service practically universal in its character. And it is not yet 35 years since Bell exhibited the first telephone at the World's Fair in Philadelphia.

TYPE OF SWITCHBOARD TO WHICH SUBSCRIBERS' LINES ARE CONNECTED

The story of how this baby of 1876 grew into the giant of today is fascinating indeed one of the "fairy tales of science." Through all of the rebuffs and doubts that invariably impede the first steps of any successful inventor, Bell and his intimate friends apparently never doubted the successful realization of Bell's prediction that sometime the telephone would be in universal use—that every person in this world would be able to talk to any other person no matter where he might be at the time. To these men this never was a dream—they *knew.*

When Bell published his first prospectus he said in it: "The proprietors (of the Bell Patents) are now prepared to furnish telephones for the transmission of articulate speech between instruments not more than 20 miles apart."



LONG DISTANCE TELEPHONE SWITCHBOARD

The people looked on the telephone as of local use but laughed at Bell's ideas of ultimate universal service, and when Theodore N. Vail, who has done as much and is doing so much to make universal service a fact, built a line from Boston to Providence it was called "Vail's folly." This "folly" gave us the metallic circuit and made certain the long distance line.

It was soon learned that the use of iron wire on long distance lines would have to be abandoned and copper substituted, because, although iron has a very decided advantage in point of first cost, in all other respects except tensile strength copper is vastly superior. But copper wire had one serious drawback—it would stretch and at first that fault called a halt in its use. As always in such an emergency, the men were found to overcome the difficulty.

Mr. F. B. Doolittle and Col. Mason were the "men of the hour" and after many experiments at Bridgeport, Conn., discovered that after the copper wire had been drawn while hot, if it was redrawn cold through dies, the inner core remained soft while a hard shell was formed on the outside which prevented any material stretching.

About this time Vail organized the American Telephone & Telegraph Company, and after building an experimental line from Boston to New York, this company built its first commercial line between New York and Philadelphia in 1885. This line was built of hard drawn copper wire weighing about 172 pounds to the mile.

In the early days of telephony one wire only was used, the return current being sent back through the ground. With this method in use, serious difficulties were encountered, chief among which were the strange and unaccountable noises heard in the receiving instruments. There were many causes for these noises—a swinging wire, the passing of clouds or bodies of air charged with electricity causing currents to flow to or from the earth—the proximity of other wires, etc. Telegraphic signals could be heard in the telephones on a line running parallel with a neighboring telegraph line for a very short distance.

When two telephone lines ran side by side, a conversation carried on over one line might be heard on the other. This phenomenon was aptly termed "cross talk."

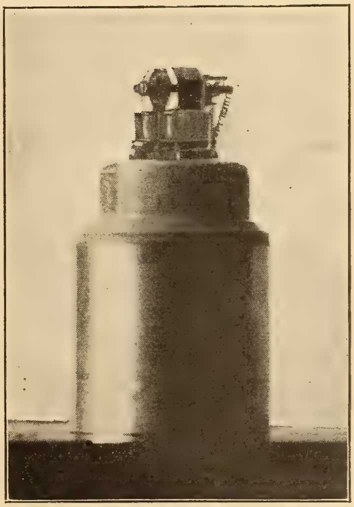
Cross talk was a serious handicap and had to be removed. After many months of experimentation a plan was hit on to remove induction and cross-talk interference.

This was accomplished on the Philadelphia line where there were ten or more pairs of wires on the poles and was done by "transposing" as it is called. This means simply the changing of the relation of each wire with its neighbors by crossing over at short distances, a change every mile on some wires to every quarter mile on others.

The Philadelphia line was followed by the construction of a similar line to Boston, another to Albany and Buffalo and an extension of the Philadelphia line to Pittsburg, using wire 172 pounds to the mile. As a result of a long series of experiments it was found that the use of this size of wire was good only for about 500 miles, and this fact led to the adoption of copper wire weighing 435 pounds to the mile as the size to be used between New York and Chicago, the great objective point of the long distance lines at that time.

The first line to Chicago was completed in 1892 and Alexander Graham Bell, on the 18th of October talked from the New York office to the Mayor of Chicago and others present at the Chicago end of the line on Quincy Street.

SMALLEST MOTOR IN THE WORLD



SMALLEST MOTOR IN THE WORLD

M. G. Trevet, a French mechanic, recently constructed at Bellevue an electric motor so exceedingly small as to be worthy of the honor of being submitted to the French Academy of Sciences. This motor though probably the smallest in the world is a carefully constructed machine, comprising all the essential parts of an industrial unit, with a Gramme ring armature, the inductor shaft of which is only 0.59 inch in length. The field coil of the machine (which is practically the same size as shown in the illustration) comprises no less than 600 turns of a wire obviously of extremely small diameter, some hundredths of a millimeter.

The rotating part or armature of the motor is only 0.244 inch in diameter. In spite of these minute dimensions it is most carefully subdivided, being provided with twelve teeth and coils wound in six sections of an aggregate of 288 turns, the useful length of wires being 65.5 inches.

The commutator consists of six minute plates kept together by ivory cones and insulated by ebonite plates, the diameter of the whole being only 0.11 inch. Each of the brushes consists of two plates kept together by three rivetted cross-stays and pressed permanently against the commutator by a ring, screw and spring. They are 0.118 inch in length, 0.039 inch in width and only 0.027 inch in height, and capable of a most accurate adjustment. The shaft of the motor is 0.031 inch in dameter.

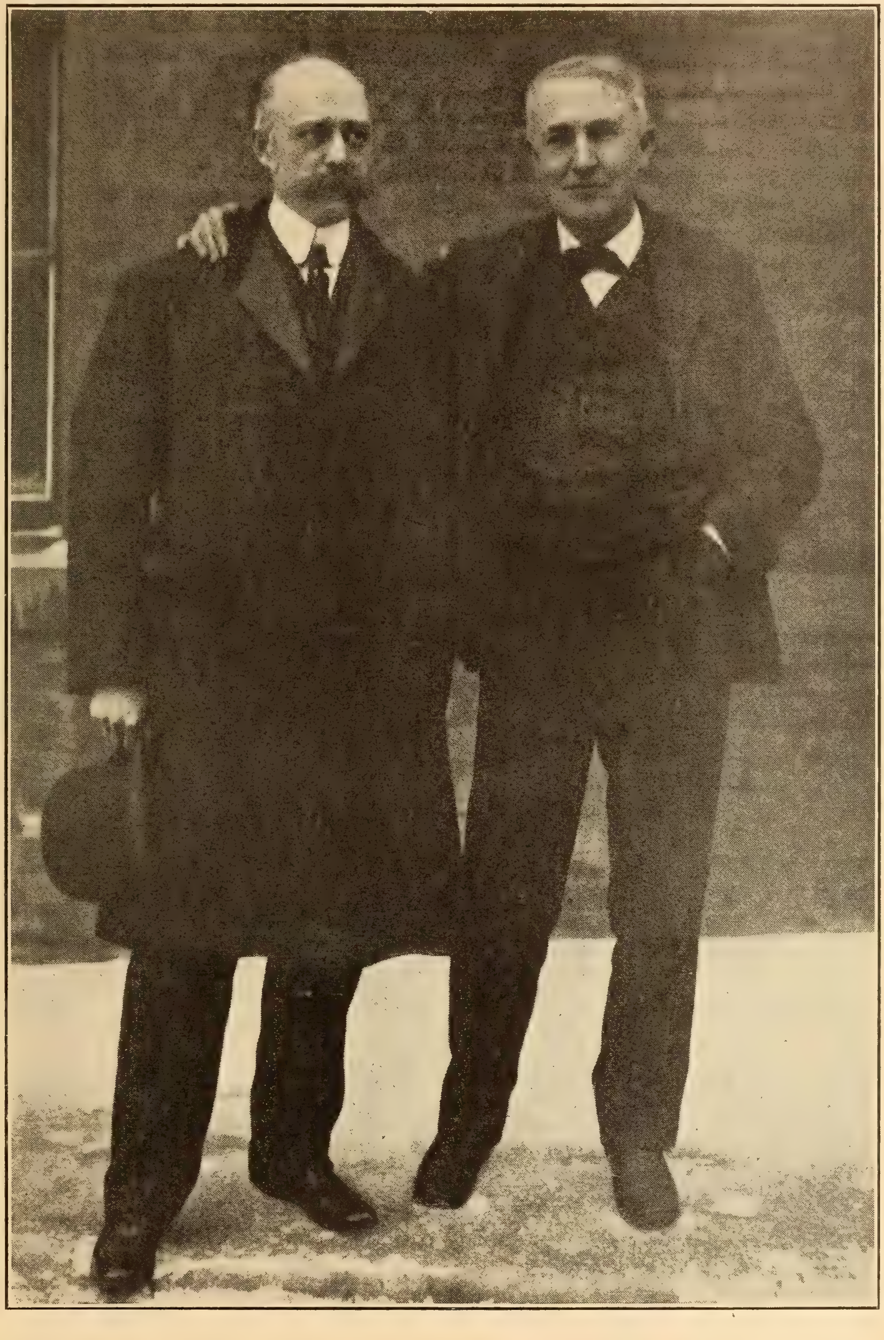
The consumption of energy in full operation is 0.7 watt or 0.00093 horsepower. The total weight of the machine is 0.0154 pound.

Edison and His Work

It is a good thing that Americans should be made better acquainted with their greatest living fellow countryman, Thomas A. Edison. Most people will arise from reading the recent biography of him, it is certain, with a very different impression from what they had before. This life, by Frank L. Dyer and T. Commerford Martin, issued in two volumes by Harper & Brothers, is not only the story of a wonderful career, typically American, but reveals the amazing extent of one man's inventive work and his deep imprint on several leading industries. Incidentally, with Eidson as the central figure, it is a vivid and complete history of electrical development during the most fruitful period of the most modern of arts and sciences.

There are some advantages in getting the biography of a great man while he is still alive, even if he goes on adding to the luster of his fame after it appears. For one thing he has a chance to know something about it himself. In this instance, Edison has read every word, and the book is published with his express consent. Little chance for error or misstatement there! Moreover at many points in the narrative Edison contributes racy pages of autobiography, some dictated but much of it written in his own hand. One of the authors, Mr. Martin, to whom the bulk of the text is due, has been a leading electrical editor and author for thirty years, and began such work in Edison's laboratory and service. The other, Mr. Dyer, has charge of Edison's business and legal affairs, and for years has conducted all his patent suits and the patenting of his multitudinous inventions. In other words, the biography has been written from the inside, and not from the outside by some one attracted by the opportunity of the theme. To the aid of Messrs. Dyer and Martin came Mr. W. H. Meadowcroft, another old Edison man and electrical writer, who spent over two years ransacking Edison's papers, files, notebooks and records, to make sure of every point. Other competent men have helped, like Mr. Samuel Insull, for years Edison's private secretary and *Fidus Achates;* or like Mr. Francis Jehl, who gives an intensely interesting account of early days at the famous Menlo Park laboratory, from which came in such swift and startling succession the Edison telephone, incandescent lamp, dynamo, complete lighting system, phonograph, motion picture apparatus, and a host of other inventions there conceived but hammered out at Llewellyn Park. Last but not least Mrs. Edison has furnished from her own collection several special and unique photographs of her distinguished husband. All this goes to the making of a remarkable book, not only lifelike in its picture, but authentic and authoritative forever.

The scheme of the book may be commended. The story of the life is allowed to proceed naturally from stage to stage, and around it is woven the story of the art. Thus we see the youthful environment of the inventor and come to understand the process of his mental development and his relation to the times. Then other chapters are devoted to the social side of Edison; to his methods of inventing; to his place as a manufacturer; to his vast struggles in the courts to sustain fundamental patents; to the value of his inventions. All this is done in a stirring manner; with an excellent style in narration; and the book literally teems with anecdote, always the more racy when told, as it often is, by Edison himself. Picture after picture of events is presented: Edison as a little boy sitting on goose eggs to hatch them; as a telegraph operator in the South in war days, getting free lunch at night at a church nearby, where the man with the Reno wheel was in the pulpit and the gamblers sat in the pews; as a youthful experimenter in Boston making nitroglycerine and dropping it into the sewer in alarm to get rid of it; as a ticker operator on Black Friday in New York climbing on top of the Western Union booth in the Exchange to watch the excitement and glad he was poor; as an inventor listening awestruck to his own first telephone as it talked and sang; as a leader of the workers at Menlo Park watching the fitful gleam of the first incandescent lamps; as a pioneer of lighting in New York, sleeping on iron pipes in a cellar or listening through the watches of the night while his friends "Adonis" Dixey recited to him or Remenyi fiddled; as a visitor to Europe occupying the French President's box at the Opera by invitation; as an American story teller trying in Germany to make Helmholtz



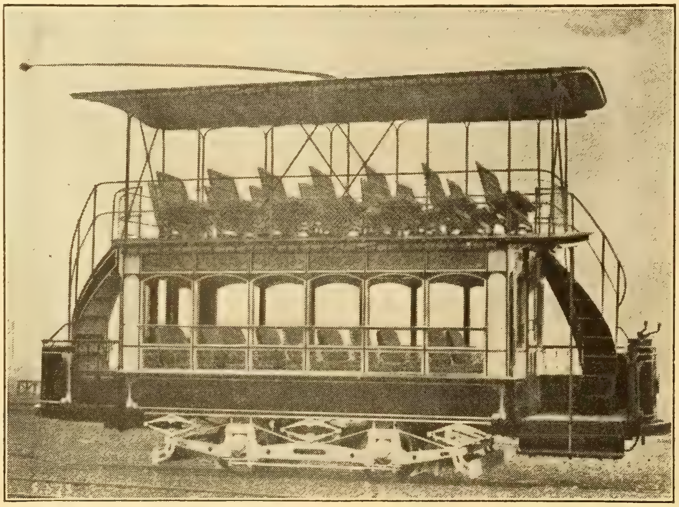
HITHERTO UNPUBLISHED PHOTOGRAPH OF THOMAS A. EDISON IN FRIENDLY POSE WITH T. COMMERFORD MARTIN, ONE OF THE AUTHORS OF THE EDISON BIOGRAPHY catch the point of a joke. Such striking episodes are endless and all go to complete the portraiture.

But the great impression given by the book, when all is said, is that of Edison's marvellous patience and perseverance. Here we put our hand on the secret of the long series of gifts to mankind; of his additions to our resources of civilization; of his triumphs over nature and the unknown. It does not follow that every man, with equal effort, could produce like results; but it may safely be asserted that no one, young or old, can read this record of indomitable and dogged resolution to reach each goal, without being stimulated in other strenuous tasks. It is a splendid book to put in the hands of young men. They may not work 48 and 72 hours at a stretch, or be called on to make 50,000 experiments as he has done along a single line, but if they are to amount to anything they will have difficulties and obstacles to overcome. Edison bids them follow his path to success and shows them how.

This "book of the year," is all the more valuable for having a complete, dated list of all Edison's patents; and a series of appendices each devoted, in the style of POPULAR ELECTRICITY, to an illustrated analysis of his patents or any group of inventions. In this manner the pages of the story are not overloaded with technique, but he who wants to know all about it, has the one part of the work to supplement the other. Electrical biography has need of such books as this, which cannot be given too hearty a welcome.

FRESH AIR TROLLEY CARS

The history of electric street cars has been replete with vacillations, as there are many tastes and ideas to be met, and yet there is a general sameness to the types used throughout this country. But when we cross the ocean we find other types, embodying changes due partly to the easier going pace of the public and partly to the milder climate which is more conducive to outdoor traveling. In countries like England, where locked compartmens are still expected on the railroads, our summer style of cars open to a running board at the side would hardly meet with general favor. But there is an approach to these in a closed car with an open smoking compartment at each end.



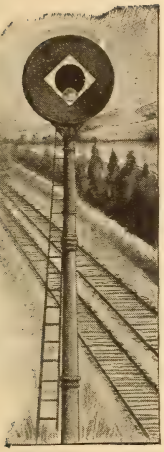
FRESH AIR TROLLEY CAR

In this country the recent tendencies have all been towards cars which can be filled and emptied with the least delay, hence the stairways and small platforms of the British types would be out of the question. Where the delays when stopping are not so serious, a much better chance for viewing the scenery along the route can be given by double-decking the cars, as is done in the tramway cars of which Hurst, Nelson & Co. Ltd. have built nearly a thousand for the London County Council during the last few years. Some of these British double-deckers have open observation platforms at each end, while others have the whole upper story open down to its floor. Perhaps if the fresh air agitation fathered by the anti-tuberculosis societies continues, we will have similar cars in this country, but at present Great Britain is certainly ahead of us.

Electric Block Signaling

By SIMON DEUTSCH, E. E.

PART II



Although quick to voice its opinion, the general public is as yet entirely unfamiliar with the requirements, operation and detail features of train protection. For this reason, among others, Congress but recently appointed a body of experts, and appropriated a considerable fund for investigation and recommendation of appliances properly to protect and facilitate train movements. This work is in the hands of the Interstate Commerce Commission, and has for its purpose the enactment of legislative measures by Congress, compelling railroads to install protective devices to safeguard the lives of their patrons and employees.

That train accidents are of too frequent occurrence on our railways is generally recognized, and perhaps, strange as it may seem, by no one more keely than by the operating officials of these railways. Accidents and delays are items of enormous expense to a railway, and it is safe to assume that these same officials on whom we generally place all blame, expend more energetic effort to prevent accidents than onyone else. Still these same men must show profit from the divisions for which they are responsible just as would be expected of any department managers of a mercantile business, and investments tending to cut heavily into these profits necessarily must be eliminated.

With the equipment and ingenuity now available it is theoretically possible to protect every foot of rail for all classes of traffic, but it must be understood that the expense of installing, operating and maintaining such complete protection would be so enormous as to be prohibitive on all but a very few railroads, as same would in all probability exceed the net revenues of the road.

LANGUAGE OF SIGNALS

Fig. 1 is a graphical representation of the language of signals. The presence or absence of a train in a "block" is indicated by the signal or signals governing that "block."

The "home" semaphore, or "position" signal, indicates "danger" or "stop" when the blade or arm is at right angles to the signal pole.

The "clear" or "proceed" indication is given when the blade is 60° or 90° from the horizontal. The same indications are displayed at night by lights, red for "danger" and generally green or white for "clear".

The same positions and indications displayed by "distant" signals, regulate the approach of trains to the "home" signals; the "distant" signal being the warning signal.

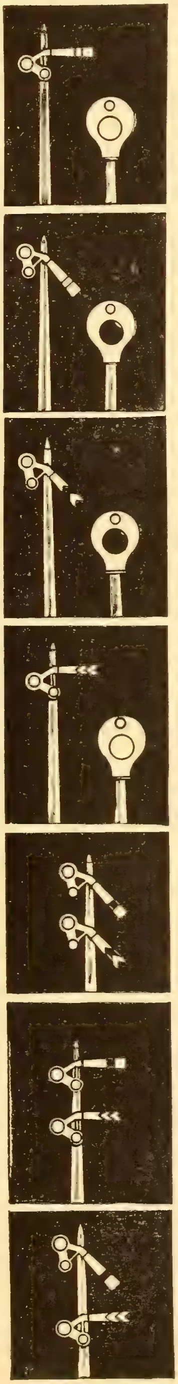
Where no semaphore signals are used, all indications being given by lights placed behind colored lenses, the red and white are generally used, conveying the same information as the lights of the semaphore or disk signal.

LOCK AND BLOCK SYSTEM

The numerous difficulties arising in the proper signaling of single track road, is due to the fact that it is necessary to protect trains not only moving in the same direction, but also in opposite directions on the same track.

Most of the mileage of the railroads in this country is single track, on which trains operate in both directions. Over the greater portion of this mileage, trains are still handled under the simple telegraph block system, described briefly in the preceding article, and with which most of us are more or less familiar. This system depends entirely upon the care and watchfulness of the operator and becomes inefficient with increase in traffic.

It can be somewhat safeguarded by adding to it such features as to compel the operators at both the entrance and exit of a block to co-operate with each other before being able to give a clear signal to an approaching train. This is generally accomplished by means of a



Home signals showing "Stop".

Home signals showing "Clear" or "Proceed."

Distant signals showing "Clear" or "Proceed"

Distant signals showing "Proceed" with caution to next signal.

Signals showing two blocks in advance are "Clear".

Home and distant signals showing "Stop".

Home signal showing "Clear" or "Proceed" but distant signal, showing second block in advance occupied and to be approached with caution.

FIG. 1. THE LANGUAGE OF SIGNALS

combined operating and locking device similar to that shown in Fig. 2.

Fig. 3 shows the interior of the instrument, the upper part containing the electric locking and release device, and the lower part the mechanical signal operating mechanism. The locking and release feature consists of a rotary switch, for closing and opening the controlling current, and a pair of electromagnets, which when properly energized unlocks the plunger mechanically locking the signal operating mechanism. By pulling out the plunger, the signal operating lever is unlocked, and same can be rotated, which it will be noted, operates the signal blade.

Fig. 3 clearly shows the pipe connections between the signal blades and station instrument.

For communicating with each other, a bell code is generally installed between block stations, operators conveying information by pressing a push button a prescribed number of times, which rings an electric bell a like number of times. This is a very simple circuit, and generally installed independent of the station instrument circuits.

Fig. 5 shows diagrammatically, a typical layout and wiring between block stations. (A), (B) and (C) represent the three block stations on a single track road, and all trains approaching or entering the blocks (AB) and (BC) are governed by the train order signals in front of each of the stations.

Supposing a train wishes to move from (A) to (B); the operator at (A) must ask the operator at (B), by means of the bell code, to unlock his machine so that he (A) can turn his signal to "proceed" position.

No train being in the block and the opposing signal at (B) being at "stop," the operator at (B) so manipulates his unlocking key as to close an electric circuit from a battery at (B) through the interlocking key, held in its proper position, and the coils of an electromagnet at (A). This action releases a hand lock, which is moved to unlock the signal crank, allowing the operator at (A) to clear his signal. After the train has entered the block and has been so reported, the signalman at (A) must return his signal to the danger position. In doing so the lock on the operating crank is forced home, thereby compelling the operator to obtain another release in order to again clear the signal.

Referring to the same diagram, the description of the circuit is as follows:

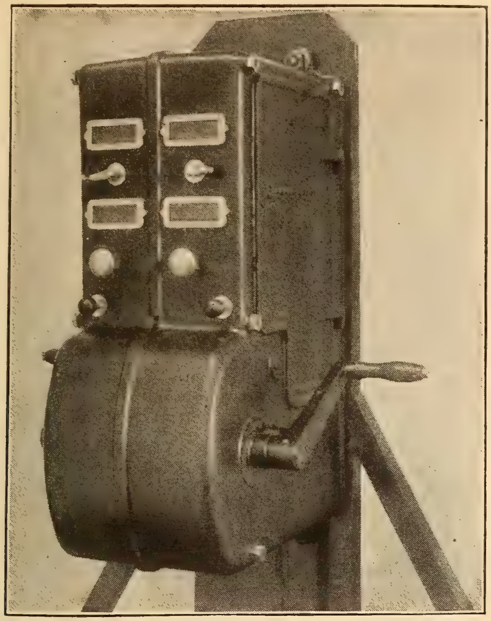


FIG. 2. COMBINED OPERATING AND LOCKING DEVICE

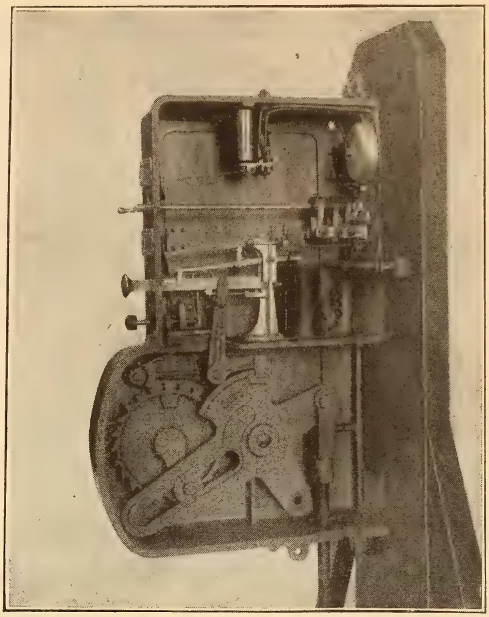


FIG. 3. INTERIOR OF OPERATING AND LOCKING DEVICE

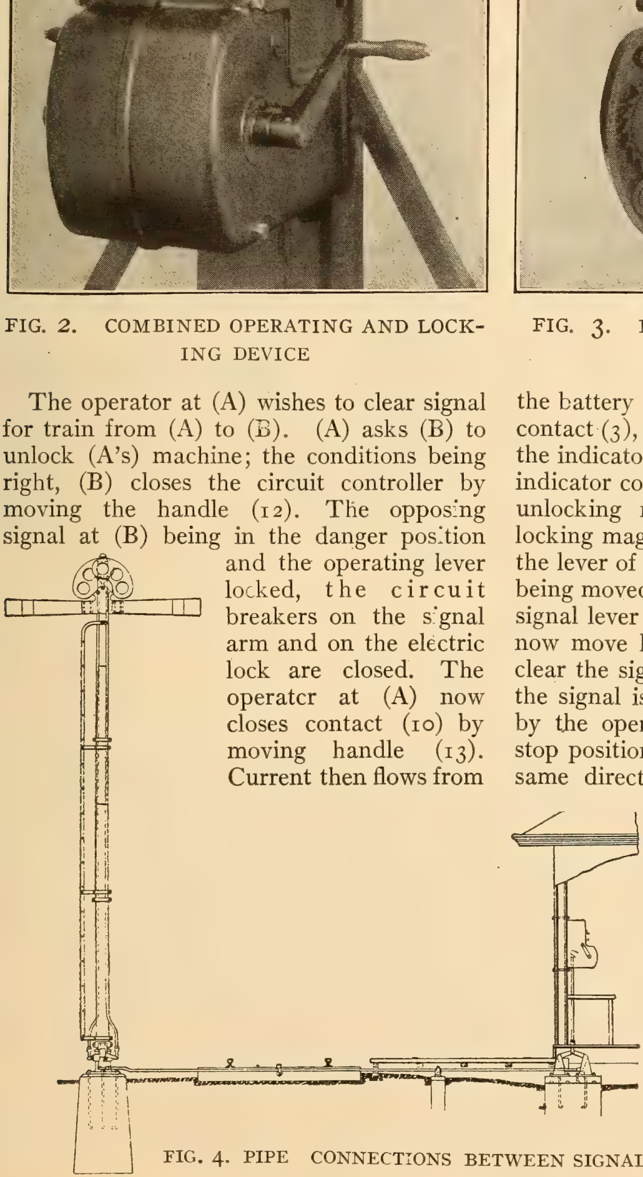


FIG. 4. PIPE CONNECTIONS BETWEEN SIGNAL BLADES AND STATION INSTRUMENT

The operator at (A) wishes to clear signal for train from (A) to (B). (A) asks (B) to unlock (A's) machine; the conditions being right, (B) closes the circuit controller by moving the handle (12). The opposing signal at (B) being in the danger position and the operating lever locked, the circuit breakers on the signal arm and on the electric lock are closed. The operator at (A) now closes contact (10) by moving handle (13). Current then flows from the battery at (B) over wire (1), contact (2), contact (3), wire (8), through magnet coils in the indicator at (B), and magnet coils on the indicator contact (10), wire (11), coils of the unlocking magnet to ground. The unlocking magnet is now energized to release the lever of plunger lock (15). Plunger (15) being moved in turn releases the lock (17) on signal lever (19). The operator at (A) may now move lever (19) one-half revolution to clear the signal. After the train has passed the signal is restored to the "stop" position by the operator. To restore the signal to stop position, the lever (19) is moved in the same direction as to clear the signal, the revolution being completed.

To prevent the lever from being turned except in the proper direction, a ratchet wheel (18) is mounted on the crank shaft. On this ratchet wheel a lug (22) is fixed, which, when the signal lever (19) is almost restored to its normal position, so engages with arm (23) as to force the lock (17) home, thereby preventing the signal from being again cleared until it has been again unlocked. The

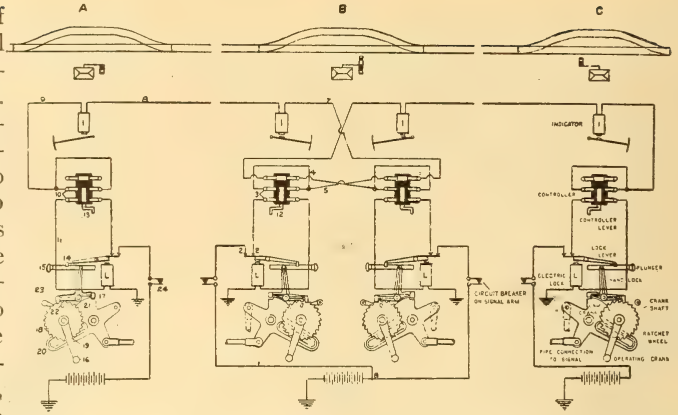


FIG. 5. TYPICAL LAY-OUT AND WIRING BETWEEN BLOCK STATIONS

electric indicators are part of the machine, and serve to tell the operators when the machine is unlocked or "released".

In this particular arrangement of the system no semi-automatic device is used to restore the signal to the stop position after the train has passed it. To obviate the danger arising from the neglect of a signal man to restore his signal to the normal position, there is usually embodied in the rules, one, that when enginemen do not see a signal change from "stop" to "proceed," such a signal must be regarded as an imperfectly displayed signal, and be governed accordingly. That is, enginemen and trainmen must see the signal change from "stop," to "proceed," otherwise must not pass it, *irrespective* of the position of the signal. Inasmuch as enginemen and trainmen must be depended upon for the proper observance of the block signals, this rule is considered sufficient for the purpose.

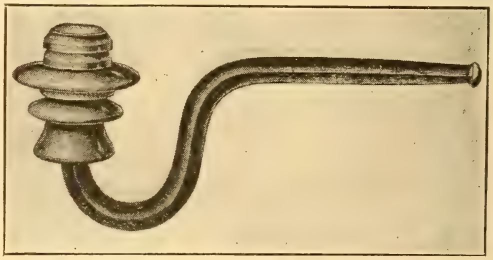
Although controlling devices of this kind installed in the manner described do not afford absolute protection in the movement of trains, still a large measure of safety is obtained by this system, which holds two signalmen responsible for the proper display of signals at each end of the block.

The realization of the need of still better means of protection and the solution of these needs in the simple manner made possible by the introduction of the "track circuit" will be of much interest to the followers of these articles, and will be fully described in the following issue.

(To be continued.)

A High Voltage Cigar Holder

The superiority of some classes of American electrical apparatus over those made in Europe has given the impression to many that electrical devices are not familiar to the average European. In the more progressive countries this certainly is not the case. Indeed, the use of electricity and its economical distribution at high voltages is now so common that the very shape of the insulators used on high voltage transmission lines has become a symbol of the up-to-date. Various novelties and items of jewelry have been fashioned in this shape and now an enterprising German firm is making pipes and cigar holders patterned after the electrical line construction. For these the bowl is shaped like the high voltage insulators used on the continent, while the shank copies the lines of the steel brackets which support these insulators on the better class of construction.



A HIGH VOLTAGE CIGAR HOLDER

Electric Dredges in the Klondike

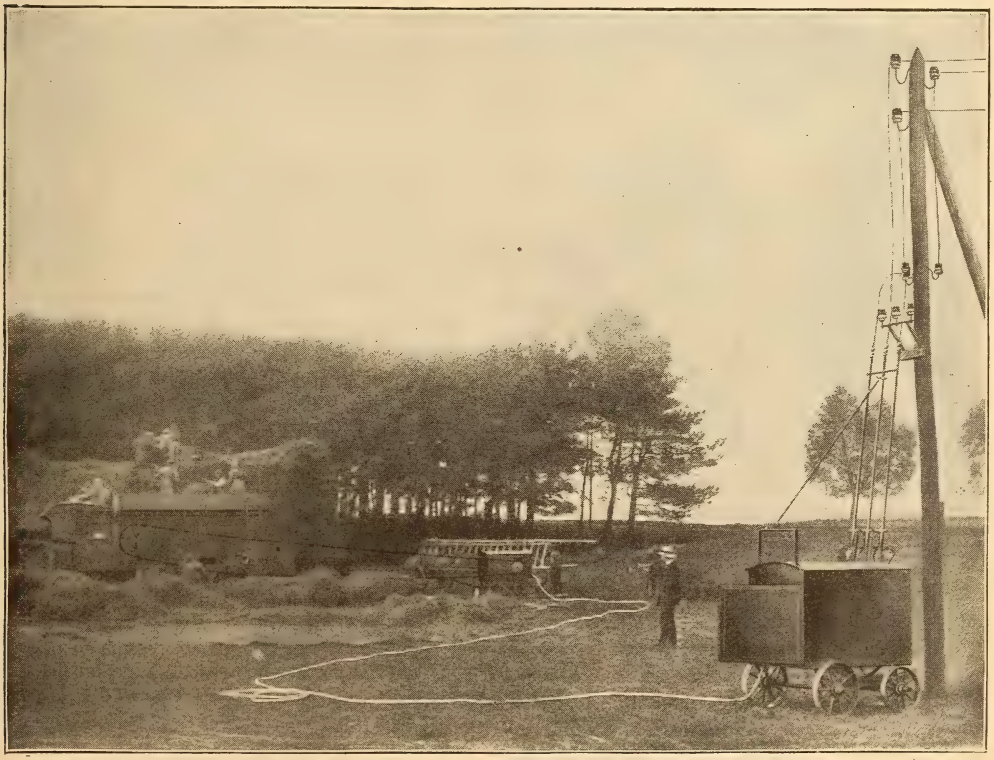
One gold mining company is building a six-mile ditch capable of carrying 20,000 miners' inches of water to supply a powerhouse for furnishing electrical power for dredges it intends building in the near future. It also intends furnishing power to other dredging companies.

Part of the machinery for this plant has already arrived at Dawson and the balance is on the way. The company contemplates decreasing the size of the ditch and adding to the powerhouse in a short time. The machinery and supplies for this powerhouse were principally purchased in the United States.

Electrical Threshing

One of the live problems now agitating both the electrical manufacturers of Europe and the leading agriculturists is that of using electricity as a source of power for farm work, preferably from central stations located in neighboring cities. All parties agree that the hours during which the power would be used in and about the fields would be almost wholly during the summer days or at the very time when there is little demand upon any electric light company for current to be used in lighting houses or stores. But when it comes to figuring out the distances to which such electric power can be transmitted economically for field use, the authorities disagree, partly because conditions vary so much at different points. However, it now seems to be generally acknowledged that the farms offer a paying class of current-users for what the Germans call "Overland Central Stations." By this they mean electric light companies supplying a network of cities not far from each other but with farm lands intervening, to which current can be supplied at a fair profit for the electric lighting company and at a decided saving in time and labor for the progressive farmer.

Of course the transmission of the current from one city to another is at high voltages which cannot be used with safety unless first transformed to a lower potential. This is usually done for city purposes by transformers located in substations or mounted on poles, but the scattering of transformers over a large farm would take too much of an investment. The modern German farmer therefore uses a portable transformer mounted in a little wagon, from which poles can make contact with the wires at various parts of the field while the low voltage current is led through an insulated cable to a motor on another cart. This makes threshing easy without the former risk of fire from the portable boiler and the motor-transformer carts can be quickly moved about for use with other machinery or implements.



MODERN GERMAN FARMER'S THRESHING OUTFIT

SIDE-LIGHTS ON ANCIENT HISTORY

TRANSCRIBED BY
EDWIN HULL ARMSTRONG

Egyptologists will be overjoyed to learn that recent excavations have brought to light some ancient newspapers printed in the land of the Pharaohs. It seems from the wording of the few clippings here reproduced that electricity was known to the ancients. Of course there are some who will question the authenticity of these records. May be so. We simply offer them at their face value.

Rameses II was seriously indisposed last Saturday night. These spells of indisposition to which Rameses II is subject are not, as a rule considered dangerous. At such times the Court Physician wraps a wet rag about the forehead of Rameses II and puts him to bed. Should anyone call, the attendant is instructed to say that his Royal Highness is suffering from Champaignus Quart Cupus or some such medical term, and that he will be O. K. in the morning.

Last Saturday night, however, Rameses II got so bad that something had to be done and that suddenly. The Court Physician was over attending a reception in the "Queen Room" in the Cheops Pyramid. As there was no one else handy the attendant called in an electric "Specialist," the kind that advertises the great curative properties of "Electric Belts," etc.

Magnetic friction of the cerebral torque

A call was left for the eminent Electro-Therapeutic Specialist, Dr. Potipariaoh and together with the "Belt Doctor" they worked over the distinguished patient.

After an examination Dr. Potipariaoh issued the following bulletin which speedily quieted public fears. This is the bulletin, word for word.

"Found patient suffering from magnetic declination, which was immediately followed by magnetic concentration. This condition quickly gave way to "Frying of the Arc" which everyone knows is usually fatal. We applied the battery and magnetic friction of the cerebral torque began to assert itself and magnetic limit was soon reached.

The ammeter showed anomalous deviation and valvular hysteresis.

The selenium resistance was series-multiple. Applying the cryptoscope was able to remove the cupric electrolysis that had accumulated as a result of the electric belt.

We cut out the heliotropism and succeeded in harveyizing the left-handed helix. My companion wished to experiment farther but I told him never to monkey with a right-handed helix."

The patient is doing nicely now, but the above shows that he had a close call.—*Cheops Therapeutic Record.*

◆

Cleopatra mailed Mark Antony a postal card. On it she asked him to meet her under the arc light near the Post Office. She suggested that Mark should have a white rose in his right hand, and that it would look cute if he could wear a couple of kingdoms under his tunic. Mark was there and Cleo took the kingdoms home.—*Wireless message to the Rome Sentinel.*

◆

The plague of locusts was on. Locucts came in such clouds that the city was in darkness four days and the people did their chores by the light of lanterns. Many appealed to the city electrician that their incandescents were faulty. That official informed complainants that he had to haul away four wagon loads of locusts from the front of the plant before he could get the door open. The locusts literally mashed the electric light poles into the ground. It was incidentally discovered that locusts are good to produce static electricity, for during the darkest hours of yesterday it lightened and thundered from this cloud of locusts. Along about four o'clock it began to hail, and what was our surprise to find that it was hailing locusts. The original dispatch sent out to the Associated Press indicated that it hailed hail, but we declare and stick to our present contention that it hailed locusts.—*Cairo Meteorologist.*

◆

Mark Antony of Rome attended our Electrical Show the other night. There is a rumor that we are likely to lose our Queen. Those who heed any such rumor do not know Cleo. It would be just as well to let Rome or any of our rivals know that Cleopatra knows a thing or two herself. Egypt has made no specialty of the Queen business, but she is well able to hold her own when other nations trot out two such easy marks as Mark Antony and Julius Ceasar.—*Egyptian Statesman.*

◇

Benjamin, younger brother of our prime minister, must have been kept pretty close at home before coming to our great city. Over at the Electrical Show the other afternoon he had to be continuously jerked away from the machinery, and once got tangled up in a dynamo and had to be laid out.

When his brothers started for home he got separated from them, and some confidence men persuaded him to go up on the plateau to see an explosion While there, another man came up and succeeded in selling him the tomb of Rameses II for $350. He made a deposit of $40, and was going to look at some other tombs, that were still better bargains, when Inspector Flanagan in company with Ruben appeared and made the sharper give the money back.

Sold him the tomb of Rameses II

Benny will get onto the ways of this town in time, we dare say.—*Sahara Daily News.*

◇

Cleopatra and some of the Court ladies left yesterday in Cleo's new electric launch the "Dawn." They were bound for Rome, to meet Julius Caesar. The new vessel is a beauty. The body of the boat is aluminum inlaid with pearl, and the stern is solid gold. The reclining couch is silver lined with satin.

Cleopatra represented Venice rising from the waters. It is said that she looked the part. We hope the voyage will be successful as the outcome means much to Egypt. With the application of storage batteries to launches and land vehicles it appears that we are at the beginning of a slaveless age.—*Nile Marine News.*

Bound for Rome to meet Julius Ceasar

◇

The editor of the *Age of Mystery* is an old moss-back fossil. He has not had a real thought since he undertook to record the aimless wanderings of a disordered fancy.

When he alludes to us as an "upstart" because we have ceaselessly advocated the use of electricity, he displays his ignorance and invites his friends to walk slow behind him. Unless he makes himself less frequent in passing remarks about us we will put a dent in his jawbone, and scatter his false teeth to the desert winds. If he feels the least bit interested in how well we like him, let him step up to the plateau where we have a large force of men working on his tomb. Let him come over some day and try our newly patented electric chair. We will guarantee entire satisfaction. After that he can enter into that perfect rest where he will be more appreciated than at present, while we continue our march of progress.—*Cairo Electric Shock.*

◇

The locusts fell so thick that they broke the backs of all the cattle that were exposed to the fury of that terrible east wind, And where the cattle were under sheds, the locusts broke down the sheds and the cattle were exposed to danger by falling timbers.

The Cairo and Alexandria electric cars were put out of commission early the first day. As the line operates upon the third-rail system the contact shoes were able to collect no juice other than locust juice, which will not drive the motors. The frog plague is even worse. Frog legs have gone down until you can buy them for 20 cents a gross. Dr. Potiplaris suggests that we import Frenchmen to eat the frogs legs. The Nubian electric freight line brought in a carload of frog legs and they stood on a sidetrack until the ice in which they were packed melted and then the shippers were compelled to sell them for a dollar and a half a ton for pig feed. Two or three department stores used frogs legs instead of trading stamps, and one newspaper (it was a yellow journal) used frogs legs for premiums in a voting contest.—*Egyptian Outlook.*

◇

About the time electricity was first used the city of Thebes was very corrupt. They would try a man for bribing a legislator. Then they would try the jury that tried the man. Afterwards they would try the judge. They did not get that system entirely weeded out until they tried the judge and the jury first. Often they would have to electrocute the whole bunch.—*Cairo Legal News.*

Talks With the Judge

LONG DISTANCE TRANSMISSION

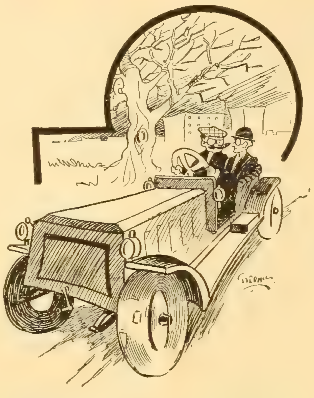
"I see by the paper that they are going to build another big power plant in California and are going to transmit current one or two hundred miles. How is it done"?

We were both in the Judge's automobile. He had just shaken hands with the crank without being hurled as usual and he was in a satisfied frame of mind. As he advanced the spark to let her out a bit, of course his mind traveled to the cylinder and then back along the ignition circuit to the induction coil, which was enough to get him started on electricity.

"Very simple proposition, I assure you," I replied. "Want the dope on it?"

"Sure," said the Judge, reprimanding an old man with a glance while he sawed his legs with the running board.

"Well, then," I began, "two things made long-distance transmission of electricity possible—alternating current and the development of the high tension insulator. The principle involved in sending electricity over great distances is to use a very high voltage or pressure, with a correspondingly small current. The power transmitted over a wire is represented by the product of volts times amperes, or pressure times current. There is another factor entering in alternating current calculations, called the power factor, but I can't explain it to you and besides it does not alter the general principle of the thing. To transmit a lot of power over a wire, therefore, if you use a very high voltage you can get along with comparatively few amperes. As the size of the wire is proportional to the number of amperes carried, you can get along with a small wire by using a high voltage and low amperage. It is just the same as though you were to undertake to pump a given amount of water through a pipe. If you were to use a pressure of ten pounds per square inch, you would need to have a large pipe to get the water through very fast. On the other hand if you were to use 100 pounds pressure per square inch, you could get the same amount of water through a very much smaller pipe, thereby saving money on the pipe.



We were both in the Judge's automobile

"Before alternating current came into use, it was impossible to obtain current at high voltage except by building a special and very costly dynamo, and even then they could only get a few thousand volts. To attempt to transmit many miles with only, say, five or six thousand volts available pressure meant that to get much power over a line a very great current in amperes would need to be sent over it—remember power equals volts times amperes. As a consequence the copper wires would have been so large and costly as to be out of the question. They would have needed to have been veritable bars of copper.

"Then along came alternating current, and with it the transformer, a comparatively inexpensive device, which will take the current from an alternating dynamo and step up the voltage almost to any point desired. Suddenly, then, engineers had equipment available for producing current at high voltages, first, 20,000 to 50,000 and lately even at 125,000 volts. Then long distance transmission became possible, for with the high voltages it was possible to use wires small enough so that to transmit current over a distance of several hundred miles, the interest on the money invested in copper wires would not be out of proportion to the receipts from the sale of the power.

"The development of long-distance transmission from fifteen or 20 miles, at first, to over 300 miles, has been largely a matter of developing insulators which would prevent the current from leaking out of or slopping over from the line. Lately, as I said, they have produced insulators which will carry 125,000-volt wires safely. When 200,000-volt insulators are made, wires will be reduced in size and the lines may then increase in radius another hundred miles."

Electric Bells Scare Birds

So familiar have electric bells become to most of us that even their sound at unexpected times or in unusual places rarely startles us. Not so with birds, to whom the sudden ringing of a bell on a tree or a post means something far more uncanny than any scarecrow flapping in the wind. Knowing this, the head master of an Austrian school has patented an electric scarecrow system in which a clock makes the connections at irregular intervals to electric bells scattered over the orchard. This unexpected ringing of bells now here, now there, is said to be quite effective in driving off the birds.

Angle Worms Sensitive Electrically

Most laymen, even if interested in the historic experiment which led Galvani to his memorable discoveries, do not find it either convenient or pleasant to repeat these tests with frog's legs. But the same principles which underlie this experiment, as suggested by a German teacher of physics, Dr. L. Spilger, can be performed with more generally available material. Place a bright silver dollar or half dollar on a sheet of either zinc or copper and lay an angle worm carefully on the coin. As soon as it starts to crawl off the coin to the zinc or copper it completes a galvanic circuit as is plainly shown by its twitching.

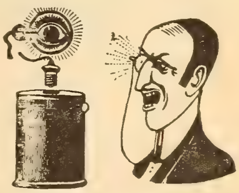
Gold vs. Silver for Mirrors

Seven centuries of silvered or silvery glass mirrors have impressed us with the idea that the really efficient looking-glass or reflector must have a silvery surface. Hence the surprise even to scientific men in finding a rival offered for this purpose, consisting of a copper reflector coated not with silver but with pure gold. With such a gold-colored reflector the percentage of red and yellow rays in the reflected light is higher than with the silvery toned mirrors and as these red and yellow rays are least absorbed by the atmosphere the light penetrates fogs more readily. In other words, a lamp of a given candle power will carry farther through the fog with a gold than with a silver reflector of the same size and shape. It is also claimed that with the former fine color distinctions can be more easily made.

This point is important not only in textile lines but even more so in warfare where protective colors are used, as for instance when a searchlight is to pick out a grey torpedo boat on a gray sea with the sky of about the same hue. A new electrolytic process recently developed in England makes it possible to obtain a fine reflecting surface during the gilding of the reflectors, and the surface thus obtained withstands the action of salt sea air better than the older mirrors.

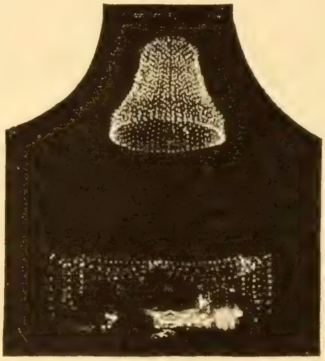
The Hypnotic Eye

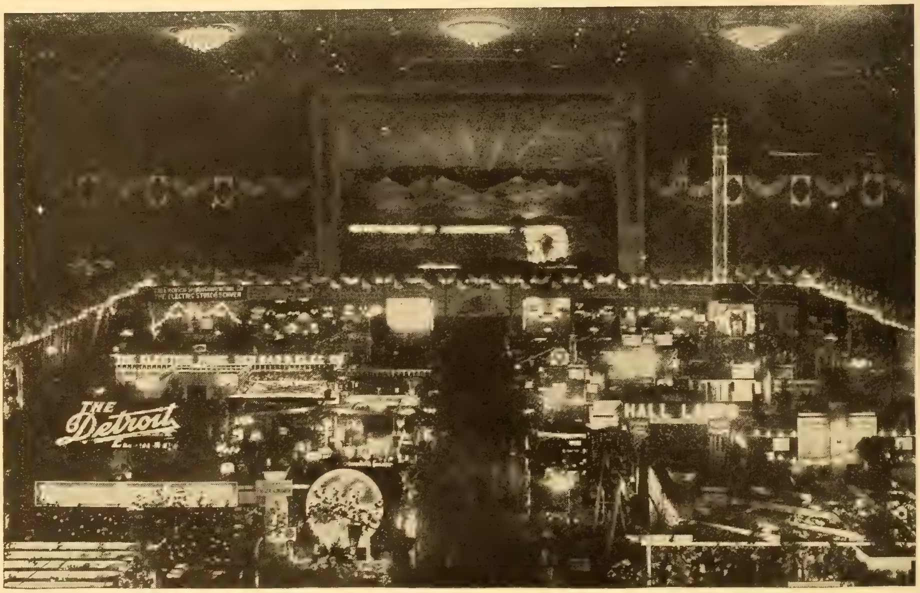
Fancy talking to a stylishly dressed man whose clothes need no label to prove their hailing from London and who is wearing that typical characteristic of Joe Chamberlain's country, the monocle. Involuntarily your eye rests on the strange monocle when suddenly this flashes with a light of its own, outdoing the dreaded "hypnotic eye" of our imaginative novelists. Such is one of the novelties offered on the British market for the benefit of those who enjoy surprising their friends. Of course it is a miniature electric lamp concealed behind the monocle which has an imitation eye painted on it, that does the flashing, current being supplied to it from a pocket battery.


THE HYPNOTIC EYE

Illuminations at Denver's Electrical Show

On the occasion of its first Electrical Show, held in October, Denver took special steps to uphold its reputation as the City of Lights. From Eighteenth Street to the auditorium, Champa Street was curtained with electric globes, red, white and blue. In front of the Telephone Building a huge bell, constructed of lights, blazed in ultramarine blue. Curtis Street was decked in ruby lights, and at the corner of Seventeenth Street a kite, fashioned of red and white lights, seemed to hang from the sky. From the Telephone Building and the new Gas and Electric Building bomb after bomb was fired, sending into the sky little balls of pink, fluffy smoke.



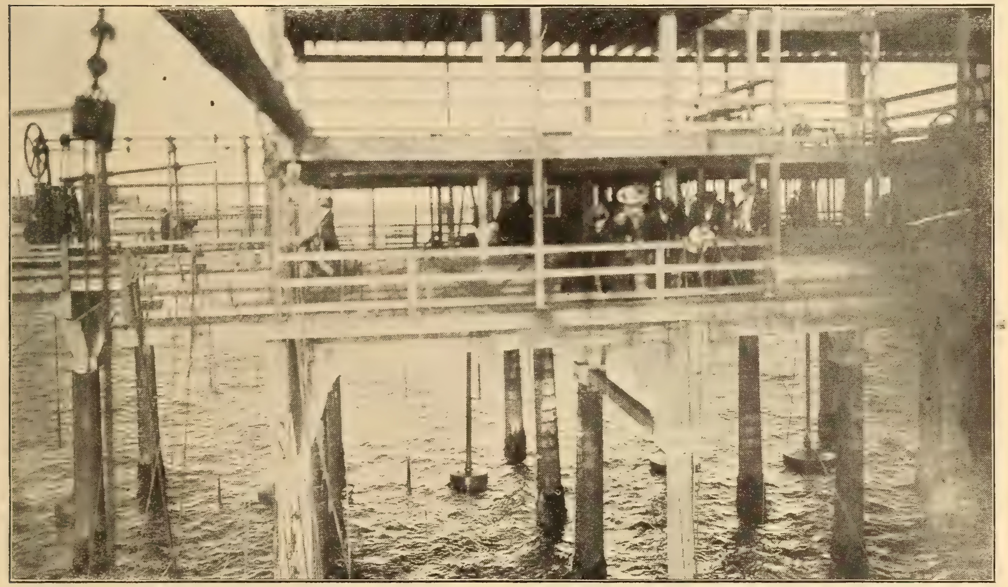


The show was held in the Auditorium, which was ablaze with light resembling Fairyland. The building was occupied by the usual manufacturers' exhibits, while in the basement the Denver Gas and Electric Company occupied a large floor space with its display, showing everything in the way of machinery and appliances used in the work of lighting a city.

There was on exhibition also in the basement the work of the boys who were taking part in the electrical competition. There were wireless telegraph outfits, electric engines, monoplanes, biplanes and a triplane, all of them made by boys from 12 to 19 years of age.

Power from Ocean Waves

The subject of the production of power from the waves of the ocean is one which has engaged the attention of scientific men and practical mechanics for many years. Whether or not a scheme will finally be evolved which will be practicable from an economic standpoint it is at present impossible to say. Some engineers in Italy have proven to their own satisfaction, if not to that of others, that the idea is not feasible as a commercial proposition. But while this arguing was taking place in Italy, a fair-sized installation which has been on the pier at Atlantic City, for some time has been demonstrating that, on a modest scale, some power at least can be developed.



THE WAVE MOTOR AT ATLANTIC CITY

Without taking sides in the argument it is not out of place here to say something of that Atlantic City installation, which some will remember having seen on one of the piers, merely as a record of one of the steps taken toward the utilization of wave energy.

In the Atlantic City wave motor an attempt is made to utilize both the up and the down motion of the waves. That this can be done was shown some time ago by Mr. D. K. Bryson of Pittsburg, with a model built into a trunk seven feet long and two feet wide, holding a seven-inch depth of water. This was fitted with a pair of buoys fourteen inches in diameter, the buoys being three-quarters full of water and attached to upright shafts connected to the mechanism by universal cone joints and ratchets. When waves were produced in the water with a swinging paddle, the buoys being lighter than the water would rise with the swell of the wave and would follow the same to its lowest depression no matter in which direction it was moving. The ratchets on the transmitting mechanism applied the power continually in one and the same direction so that the manifold motions of the water would rotate the horizontal shaft steadily in one direction. With this model the wave power would drive a six-volt generator at a speed of 2,200 revolutions per minute and at the same time would run a small air compressor.

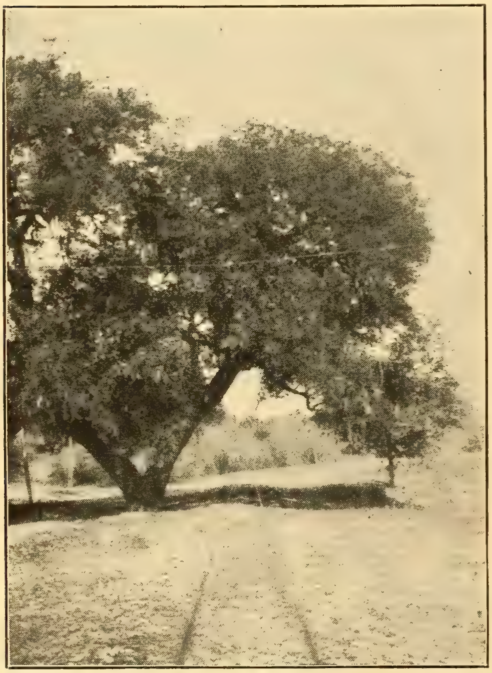
The same principles underlie the larger installations as recently tried at Atlantic City, which had buoys four feet in diameter (each displacing about 50 cubic feet of water) loaded with water to a total weight of 2,150 pounds each. This weighting of the buoys gives a larger displacement together with more power on the downward stroke and in the lateral movement. On certain occasions this installation is said to have been capable of running a 22 kilowatt dynamo also a triple action pump and another little dynamo of 2½ kilowatt capacity. No data is given, however, on the continuity of this service, the number of days on the average that the waves would run it or the cost of the installation in comparison with the possible returns from it.

It did prove however that sea waves could on occasion be made to drive quite a good-sized dynamo; which is a step of considerable importance.

For commercial installations the makers propose to use buoys in four or more parallel rows with at least eight buoys to each row, weighing about five tons each when filled, so as to insure a more uniform stroke regardless of the direction in which the sea is rolling. For electrical purposes this uniformity might be further improved, if necessary, by using some one of the speed regulators that have been developed for steadying irregular water powers. So they would have it appear the only remaining problem would be that of installing buoys sufficient in both size and number to supply the needed amount of power.

"Woodman, Spare that Tree"

The name of David Crockett is familiar to every reader of Western tales and Indian stories. In front of the old home of the famous Indian fighter still stands an ancient tree said to be over 300 years old. In extending the interurban line recently from San Antonio, Texas, to Alamo Heights sentiment refused to allow this tree to be cut down. By trimming out a few branches the traction company made a tunnel with ample space for its cars to pass through, as shown by the picture, reproduced by courtesy of the *Electric Traction Weekly*. The trolley wire was suspended from a cross-arm secured to one of the main branches.



TREE IN FRONT OF THE HOME OF DAVID CROCKETT, WITH ELECTRIC RAILWAY BENEATH

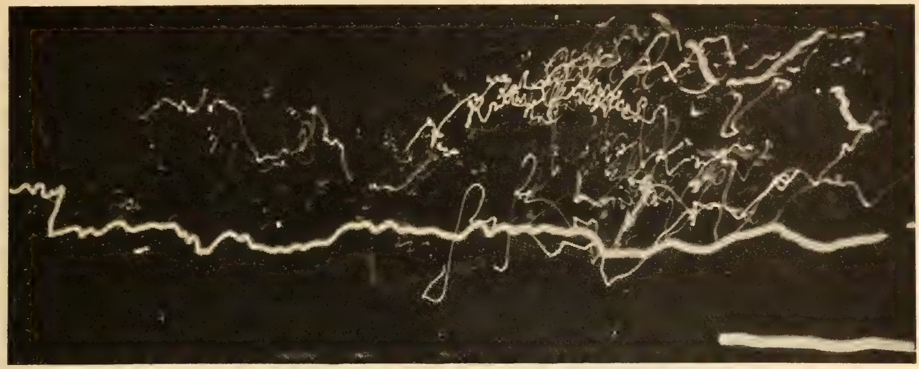
What a Moving Camera Film Shows

A writer in the *Illuminating Engineer* describes some very interesting tests made to determine the relative amount of glare produced by the window lights, electric signs, etc., in various sections of a given street. The scheme employed was in a way that of moving pictures; that is, the camera was mounted on a moving trolley car and negatives exposed directly toward the side walk and building fronts.

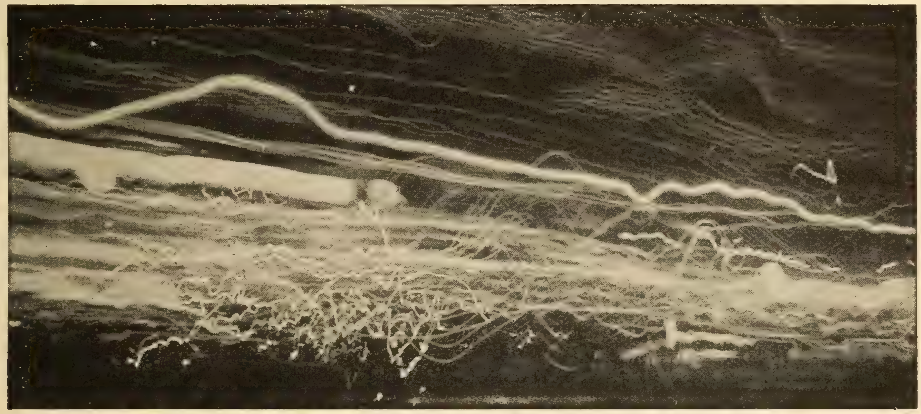
Each film was given an exposure of 90 seconds at U. S. 8 stop. An endeavor was made to screen off the camera from the headlights on automobiles and passing street cars as well as from the rows of street lamps.

The pictures were taken from a surface car running north on Broadway, New York, August 18, 1910, at about 11:30 p. m. with the camera directed towards the west side of the street.

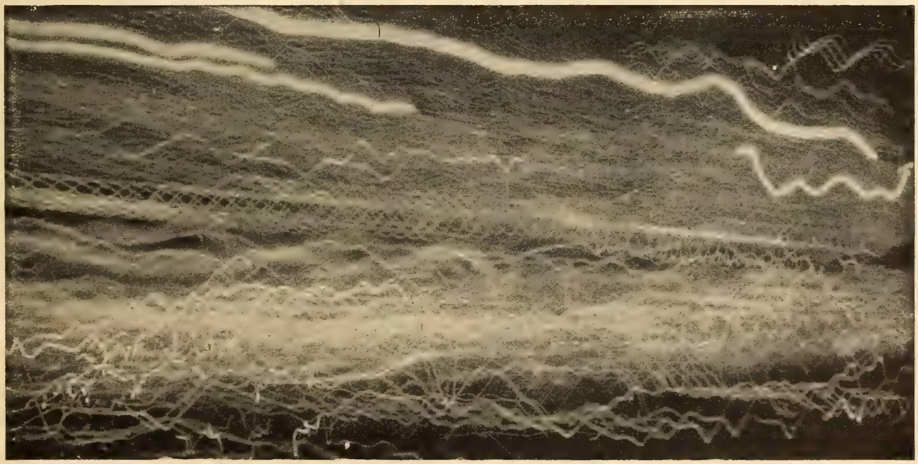
The views here shown illustrate in a novel manner the building up of street, sidewalk and show window illumination from the lower business section of Broadway, between Fifteenth and Twenty-third Streets, up and into that section known throughout the world as having the highest percentage of light flux per cubic foot of street of any English-speaking community. As the exposures were made shortly before midnight, they are but slightly representative of the business houses and show windows.



Broadway, from Fifteenth Street to Twenty-second Street



Broadway, from Twenty-fourth Street to Thirty-first Street



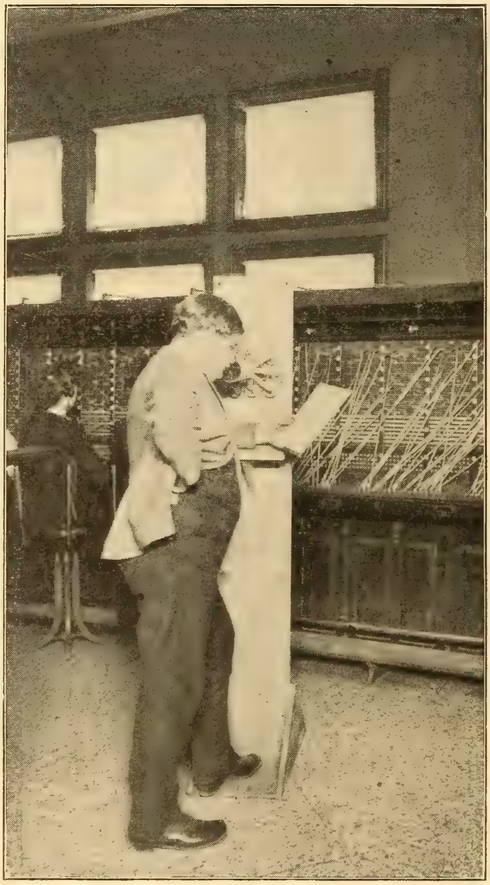
Broadway, from Thirty-fourth Street to Forty-first Street

RELATIVE GLARE ALONG BROADWAY, NEW YORK CITY, AS SHOWN BY THREE EXPOSURES OF A MOVING CAMERA

A Telephone System on Election Night

The excitement of a Mexican bull fight or of a battle for the National baseball championship pales to insignificance when contrasted with the wild, apparently distracted multitudes who fill the streets in front of newspaper offices and political clubs in a big city after the polls of a presidential or general election have closed.

Much like wild animals at feeding time, the crowd awaits hungrily and ravenously, bulletins of results from various parts of the country, and breaks into wild cheers or sullen groans or a mingling of both when the fate of this or that doubtful state or candidate is announced as swinging one way or the other.



A "READER" AT ONE OF THE EXCHANGES

Back of all the noise and human energy being set free is the silent, systematic and accurate gathering and editing of news of which the public knows little and in the doing of which the telephone is a most important factor.

On such a night in Chicago if you step to your telephone, take down the receiver and say "Bulletin, please," the operator replies, "Just a moment, and the bulletin will be read." Your call is received through what is called the "A" board and is quicky transferred, to avoid interruption of regular traffic, by way of the "B" board to other special operators who care for these inquiries and you are then at liberty to listen to the latest news condensed into the bulletin. If you saunter down the street a little later, you will probably find just being posted the information you received ten or 20 minutes before.

At a general election over 50,000 calls for election returns may be received in Chicago from subscribers of the Chicago Telephone Company and briefly the story of how this great increase in traffic can be cared for without delay to regular telephone calls is here told.

The picture on the next page shows you a force of men in a large room, on the sixth floor of the Toll Building. Into this room pours the information from five different sources. During the last presidential election the returns from the Chicago precincts and wards were obtained through a force of fifteen men on duty at the city hall, who transmitted the news to the receiving table in the Toll building as rapidly as it was sent in from the polling places

The toll lines throughout the ten counties covered by the company were utilized to obtain returns as fast as they were assembed at the various county seats.

The wires of the American Telephone and Telegraph Company brought returns from distant cities and especially from New York, and news was exchanged with the City Press Association and several Chicago newspapers.

The receiving table for information is shown located under the windows in the picture. After being taken down in its crude shape, the bulletin sheets were passed to the table at the farther end of the room where the matter was edited and arranged in shape to give out. Fifteen carbon copies were then made and one handed to each of the fifteen men "readers" who were telling the returns to the exchanges located in various parts of the city. At each exchange the returns were copied and placed in the hands of other readers, one of whom is shown in the picture, reading a bulletin to 100 subscribers at one time. To do this a funnel was arranged, from the base of which branch tubes ran to ten ordinary transmitters. Each transmitter was connected to ten subscribers, making a total of 100. As the reading of the bulletin was completed, an operator pulled out one set of 100 plugs indicating to the listeners that the bulletin was completed for the time being, while the reader by throwing a switch was connected to 100 waiting subscribers which the operator had just connected. The readers working in relays read continuously until relieved.

RECEIVING AND EDITING THE ELECTION RETURNS

Such special, quick and accurate ten-minute, thirty-minute and continuous bulletin service thus provided at a time when news agencies are rivals should afford telephone users much satisfaction.

Department Store Delivers by Electrics

Electric vehicles have now been in service long enough to pass the experimental stage and to demonstrate their great superiority over horse-drawn vehicles and other tractors, especially for service in congested districts. From standpoints of economy, speed, reliability under all conditions, durability, cleanliness, in fact from almost every conceivable viewpoint the electrically driven delivery wagon has much the advantage.

One of the most recent installations of this character is that ot the Gimbel Brothers of New York, the requirements of their large store needing the service of 36 small package delivery electrics, and 30 more for heavy hauling.

These vehicles are a splendid advertisement for the owners as they go about the city streets.

Stiffening Honey Combs

One of the serious problems encountered by the apiarists or beekeepers has been that of providing a comb "foundation" or midrib upon which the bees will build the honeycomb. To get a maximum of productivity from the bees, this foundation must also serve as a source of wax from which the material for the comb can be drawn without compelling the bees to secrete it as they would consume honey if they did the latter. To make such a wax midrib inexpensively, light and yet rigid, it requires some stiffening and cardboard or paper has been repeatedly tried for this purpose. However the bees usually sense the presence of such foreign pulpy matter and in tearing it out they waste time besides damaging the comb. This is not true when a mesh of wire or a series of parallel wires are imbedded in the wax to stiffen the same, but the difficulty in that case has lain in imbedding the wires centrally. Now this problem has been solved by simply connecting the wires to an electric light circuit or a battery powerful enough to moderately heat them, the current being shut off when the wires have sunk half way through the wax. The softened wax readily rejoins over the wires, leaving these as an effective and inexpensive means of stiffening the wax rib.

Camden's Unique Fire and Burglar Alarm System

Burglars and holdup men steer clear of Camden, N. J., and for good reasons. By a combination system of mechanical signals, telephones and lights, the bold, bad man finds himself in the toils before he gets very far from the scene of any unlawful activities. The Electrical Bureau is justly proud of the whole equipment, which includes also a fine alarm system.

In the police service patrolmen are required to report to headquarters every hour. A policeman is shown in the act of doing this by pulling down a lever inside a patrol box. An officer at the station receives the report punched on a paper tape by an electric register the circuit of which the man at the box is operating. At the same time the policeman knows he is getting credit for his call by the bell in the box tapping back in response to the register. If he does not get this signal he uses the telephone in the box which lights a red lamp in front of the operator at the station who then receives the report by telephone.

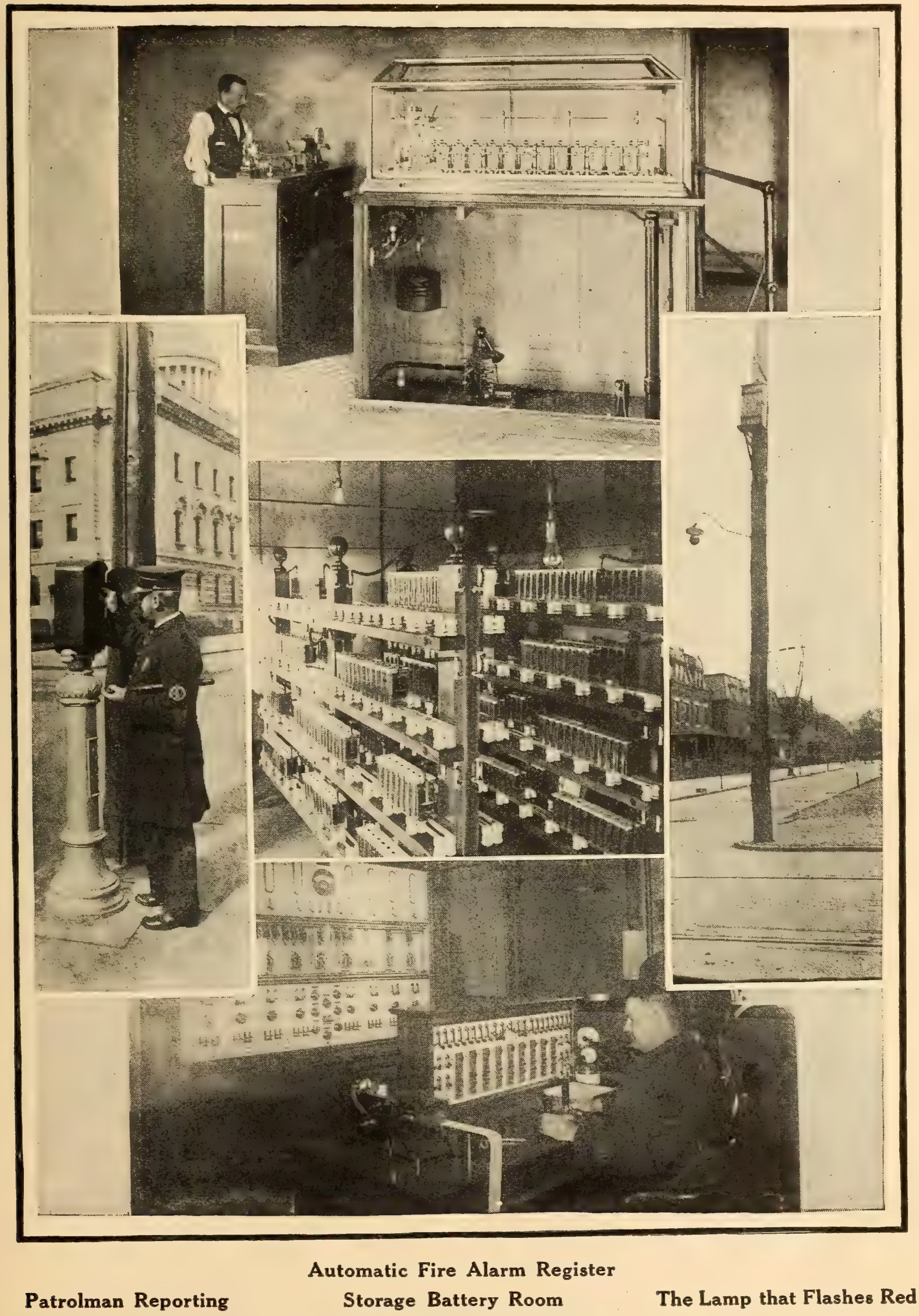
One of the best and most serviceable things in the whole system is "the lamp that flashes red." A telephone call comes in to headquarters that a residence has been burglarized. The location and a partial description of the thief is given but the patrolman has just "pulled the box" and ordinarily would not be within reach for an hour—plenty of time for the robber to escape with his booty. Not so with this system. On his way down the block from the box the patrolman is suddenly roused to action by the flashing of a red light ahead. He hurries back to the box and over the telephone receives orders to catch the thief. At the same time other patrolmen are being notified and the whole force is at once on the look-out.

Chief J. W. Kelley says, "The lights work well with us. Recently a stabbing affair took place, the offender being a colored man. It was promptly reported to the Police Department, the red lights were turned on and the man captured in 30 minutes. We got him just going on board a ferry-boat. Five minutes later he would have been out of the State."

The lights are also used in arresting "joy-riders," the first officer telephoning in the automobile number which is relayed to the man at the end of the street. Five red lights to a circuit located 23 feet in the air on convenient electric light or telephone poles are so arranged that no matter which way the patrolman may go from the box, it is impossible for him not to see one of these lights ahead of him if it flashes. Bells are also used, but the lights get a quicker response, a recent test on one circuit getting five men in two and a quarter minutes.

The Bureau's automatic fire alarm register shown in the picture is fondly called a "$3,000 beauty," the insulating blocks upon it being of onyx. This instrument records the alarm calls on a tape stamping the date, hour, minute and second. In an almost human manner it forwards the calls to the proper engine houses. Every operator in the place might drop dead but the alarms would be cared for just the same ten at a time.

To guard against any failure of current to run the systems a storage battery capable of supplying service for five days without charging is kept in readiness.



Patrolman Reporting

Automatic Fire Alarm Register
Storage Battery Room
Operator's Desk in Police Station

The Lamp that Flashes Red

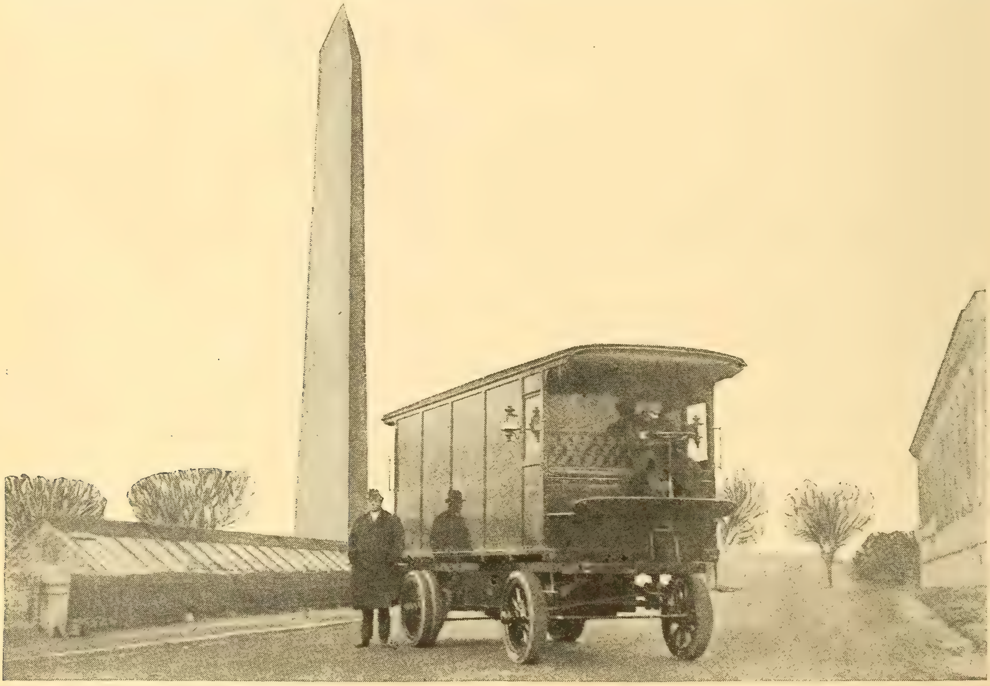
Uncle Sam's New Money Car

One of the largest and heaviest electric automobiles in the world has just been specially designed and constructed for the United States government at a cost of $5,000, and, for all that it has just been placed in commission it has brought about an innovation of method and equipment so successful that it is already planned to order a second commercial vehicle of this type at an early date.

The new motor truck which is technically designated a "money car" is the property of the United States Treasury Department and its function is to transport newly-completed paper money from the United States Bureau of Engraving and Printing where the currency is printed to the Treasury Building proper, where silver and gold certificates, bank notes, etc., are stored in the huge reserve vaults, to be drawn upon as needed for the replenishment of the circulating medium.

The money manufactory is located about half a mile from the Treasury Building and inasmuch as from eight to twelve tons of the new made money must be transferred daily it will be seen that the task is of no mean proportions. In this delivery service the new motor car is to displace a heavy steel-lined wagon weighing 6,800 pounds and three heavy draught horses which have engaged in this task continuously for more than eleven years past.

Investigation and experiment by the government officials proves that on an even basis as to carrying capacity the new electric van would be more economical to operate than the three-horse wagon, but on top of this economy in what might be termed basic operating expenses is the fact that the new electric vehicle with its carrying capacity of five tons will carry, under the standard Treasury method of loading its valuable freight, fully 50 per cent more money than the old car. And finally the speed of the self-propelled vehicle will enable it to do extra work over and above that possible with the horse-drawn vehicle. Indeed, it is planned to have this new electric car not only deliver the paper money to the Treasury but also to deliver to the Post Office Department at Washington all the postage stamps printed



UNCLE SAM'S NEW MONEY CAR

to its order,—another important product of the Bureau of Engraving and Printing for the handling of which extra wagons have heretofore been required.

The Treasury's new electric, which is expected to save the government $1,200 a year over the cost of maintenance of horses and harness, is not in mechanical and electrical details very different from other five-ton capacity trucks of the newest pattern. It has a 25 plate battery of 50 per cent overload capacity and will run 30 to 35 miles on one charge. It is the special body which makes this car unique. The car will carry from $7,000,000 to $10,000,000 in money every trip it makes to the Treasury and with a view to safeguarding this valuable cargo the Treasury officials designed a special body of steel and wood construction of the staunchest character and with the rear doors closed by locks of the heaviest pattern.

The floor of the interior of this new car,—more capacious than any circus van in the country,—is laid with steel rails and on these will be run the trucks or packing cases on wheels in which the money is transferred. Each of these boxes weighs, loaded, about 1,500 pounds and will carry a total of 412,000 notes which means $412,000 worth of notes if the denomination be one-dollar bills and $4,120,000 if greenbacks of the ten-dollar denomination be in transit. The new automobile will accommodate six of these boxes as compared with four which was the limit of the old wagon. The new car is provided with a seat at the rear for four armed guards while two other special policemen will occupy the seat with the chauffeur on every trip and a seventh officer accompanies the van on horseback in order to hold up street traffic to allow its passage and to prevent any other vehicle from approaching close to this precious carrier.

FROM OUT THE LEYDEN JAR

The work of compiling a magnetic survey of Africa has been practically completed.

* * *

Cleveland, Ohio, has a vacuum street cleaner which will, it is said, do the work of 40 men.

* * *

Canada's first great electric smelting plant for the treatment of ores is to be erected at Sault Ste. Marie, Ont.

* * *

Half a million telephone messages were sent from the Waldorf-Astoria hotel in New York last year.

* * *

A zigzag arrow has been adopted in Germany as a danger sign to be displayed on high tension electrical apparatus.

* * *

Investigation by a French chemist shows that gold boils in an electric furnace at a temperature of 2,400 degrees Centigrade.

* * *

The attention of the oil operators in California is now directed to tests being made with electric motors for pumping and drilling oil wells.

Experts have estimated the waters of the state of Washington as capable of producing 3,000,000 horsepower, of which but 163,000 horsepower has been harnessed.

* * *

All of the 20 steamers of the Union Oil company's fleet on the Pacific coast are to be equipped with wireless as fast as possible. Several of the vessels already have been so equipped.

* * *

Electrical fittings valued at $1,110,000 were imported into British South Africa during the first seven months of 1910, against only $368,000 worth in the same period last year.

* * *

To handle the telephone business in the five largest office buildings in New York City, no less than 2,360 miles of wire are required. Of these the Hudson Terminal building—or buildings, since it is a twin edifice—take 750 miles.

* * *

An electro-magnet was recently used to "fish" a broken steel drill from the bottom of a 500-foot driven well. The magnet not only brought up the broken drill but all the metal particles or borings which were in the hole.

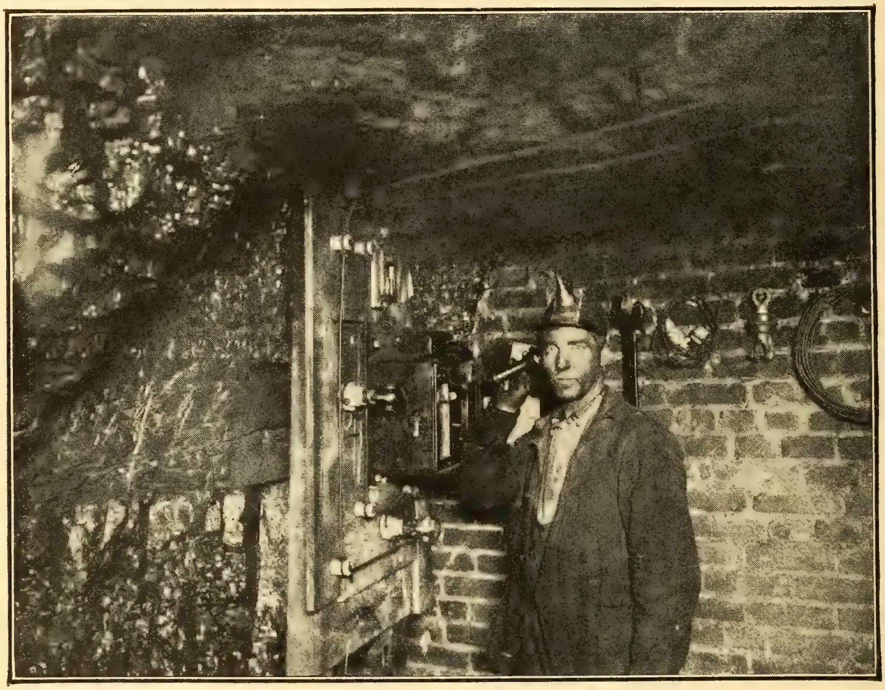
A Telephone 12,000 Feet from Daylight

The man at the telephone in the accompanying illustration is a Pennsylvania miner, standing in the engine room, 12,000 feet down a four per cent grade, from the entrance to the shaft. To obtain a flashlight photograph under these conditions was a difficult task, but the picture makes very apparent the usefulness of an underground telephone system.

The instrument shown, similar to the one described in the August, 1910, issue, is designed especially for this service. The inner parts of the telephone are protected by two iron doors, only one of which is opened when the wire is being used. The set is well protected against moisture, gases and fumes, which would make the ordinary commercial telephone useless for work in mines.

It is reported that in one of the coal mines of Pennsylvania not long ago these ironclad telephones were instrumental in locating and checking a blaze which might have proved disastrous. In another instance the telephone called a surgeon to the entrance of a shaft, to meet a car bearing an injured miner, and in this way a fatality was averted.

Through connection with a switchboard on the surface it is possible to transact the business of the mine by the telephone method. Communication between man and man underground, and connection with the upper air, once an impossibility, are now an established fact.



USING AN UNDERGROUND TELEPHONE

Induction Motor Runs Under Water

Because of the absence of a commutator and brushes from the induction motor the wires and coils can be thoroughly insulated, making this type of motor adaptable to places where such power could not otherwise be used.

A most remarkable performance under trying conditions was made by a twenty-horse-power General Electric motor of the type mentioned, the motor being located at the bottom of a shaft in the mines of the Richmond Iron Works, Richmond Furnace, Mass. Water broke in on one of the upper levels of the mine, rising so rapidly that the motor which was connected to a pump could not remove it fast enough. The motor was soon under two feet of water, but the current being left on, the motor pumped itself clear in two hours. It was then stopped, oiled and cleaned and put into service again, having suffered nothing from the severe test.

Little Batteries that Corrode Metal

Through modern research and investigation it is known that corrosion of iron and steel is caused by the carbon, sulphur, phosphorus and manganese becoming segregated, during the process of manufacture, this theory having been fully demonstrated both in the laboratory and under actual working conditions. The corrosive action takes place in the following manner:

When the impurities—carbon, sulphur, phosphorus and manganese—become segregated in iron or steel; that is, when they are not equally and evenly distributed throughout the metal, occurring in small spots or areas, an electrical current will be set up between these segregated points whenever the sheet, in which they are present, becomes covered with a film of moisture from the atmosphere. Due to differences in composition, some of these points of segregation become positive others negative, which, when connected by the film of moisture, set up numerous electrical batteries of greater or lesser energy according to the extent of the segregation, so that there are limitless numbers of small electrical batteries continually at work throughout the sheet.

It is a well known fact that a current of electricity cannot be generated in a battery without destruction or dissolution taking place at the positive pole so that in any sheet iron or steel in which segregation has taken place and the surface of which through exposure to the atmosphere has become covered with a film of moisture, there are numerous small electrical batteries at work, at the positive poles of which the iron or steel is being destroyed, resulting in the form of corrosion known as "pitting." The more marked or strongly defined the segregation, the stronger will be the electrical action, consequently the more rapid will be the destruction of the metal or sheet. On the other hand, the less well-defined the segregation, the weaker or milder will be the electrical action, and consequently the life of the sheet will be longer. Again, in a well-made sheet of iron or steel in which the impurities have been properly incorporated and segregation reduced to a minimum, the electrical action will be so slight that pitting will not take place, but instead an even coating of rust will be formed over the entire surface of the sheet in such a way that the rust itself will become, to a great extent, a protective coating, greatly retarding the process of decomposition or rusting. It was for this reason that the old time iron sheets, made by the old time slow but thorough method, withstood so phenomenally the ravages of corrosion. It was not because they did not rust that caused them to last, but the way which they did rust, that made them so long-lived.

The problem which confronts the modern maker of sheet metal, therefore, is how to produce the great quantities now required fast enough to supply the demand and at the same time of a quality approaching that turned out by the slow methods of the old metal workers.

After a long series of exhaustive experiments and tests a material has been produced which is said to meet the requirements as regards corrosion resisting properties and working qualities. This new metal is called Toncan metal. In the structure of this metal the segregation of impurities has been reduced to a minimum doing away to a large extent with the little "batteries" which make the trouble.

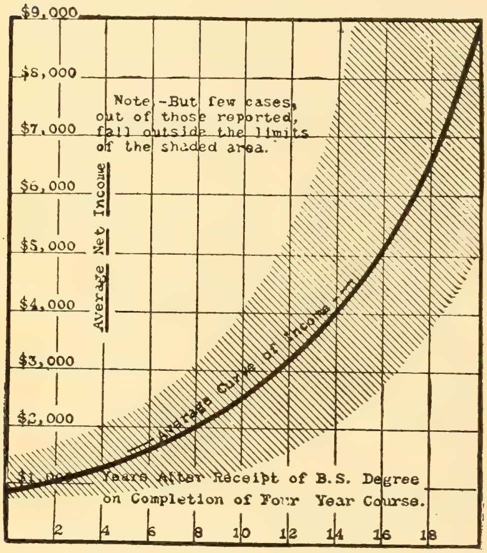
Correct Time by Telephone

The Hamburg observatory in Germany has made arrangements by which anyone in telephonic communication with that city can at any time in the day set his watch to exact Central European time. The telephone subscriber calls up "No. 4000 IV Hamburg," and can then in the last five seconds of every minute perceive a tone like that of a siren. The cessation of this tone indicates the end of the minute. In order to get the minute right, every five minutes—five, ten, fifteen, etc.—there is given an audible signal like the noise of an alarm clock. It is assumed that the watch which is to be set is within at least five minutes of being exactly right; which is usually the case. There is no charge for this service, other than that for the use of the telephone. As the signals are given automatically, it is not necessary to give the number of the caller. As soon as "central" in Hamburg IV says "connection is made," the signal can be heard. It is so loud that it can be heard in Munich, Copenhagen, Cologne, and even Paris. The signal is given by a pendulum clock in the observatory, which is provided with a number of contacts, that make and break electrical connection.

Electrical Engineers Well Paid

What returns financially does a technical school training in electrical engineering offer the average student who expects to make that profession a life work?

The self-explanatory diagram given herewith is probably as definite an answer as can be made to this question and is the work of Prof. H. B. Smith, showing the results of a canvass among the electrical engineering alumni of the Worcester Polytechnic Institute. The curve indicates an average annual income of $2,000 eight years after graduation, and $4,000 fourteen years after, a very substantial compensation.



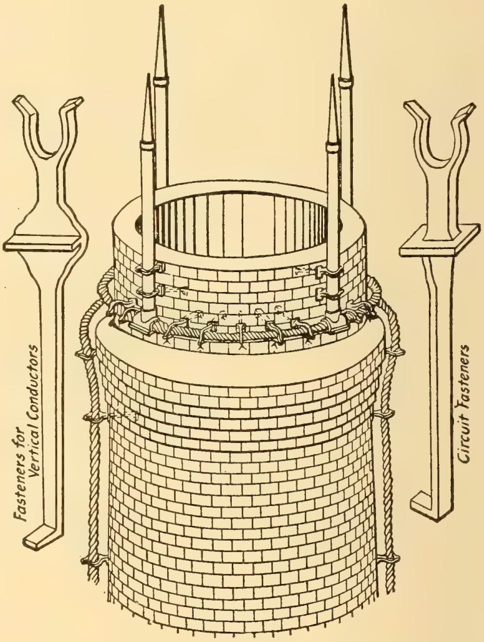
CURVE SHOWING AVERAGE ANNUAL INCOME OF GRADUATE ENGINEERS

Protecting Chimneys from Lightning

In relation to an item which appeared in the November issue of Popular Electricity concerning the utilization in Germany of steel rods embedded in concrete chimneys as lightning rods, Mr. Carl Bajohr writes as follows:

"The writer wishes to state that such action was tried in this country, about eight years ago. But one day when Mr. Lightning came and inducted the chimney, then the concrete chimney cracked in every direction where the reinforcement was placed, and the consequence was that the chimney had to be taken down and a new chimney had to be erected with lightning conductors placed on the outside where they belong. There are many such cases on record and perhaps the people at Ober Cassel in Germany will meet with the same problem some day."

The illustration shows the method employed by Mr. Bajohr for the protection of brick and concrete chimneys. The lightning conductor is of copper cable made in one continuous piece and connected at the top to suitable points or tips. The cable is fastened to the sides of the chimney by patented fasteners of various types made so as to be laid in with the brick work or else driven or screwed into holes, depending on the kind of chimney.



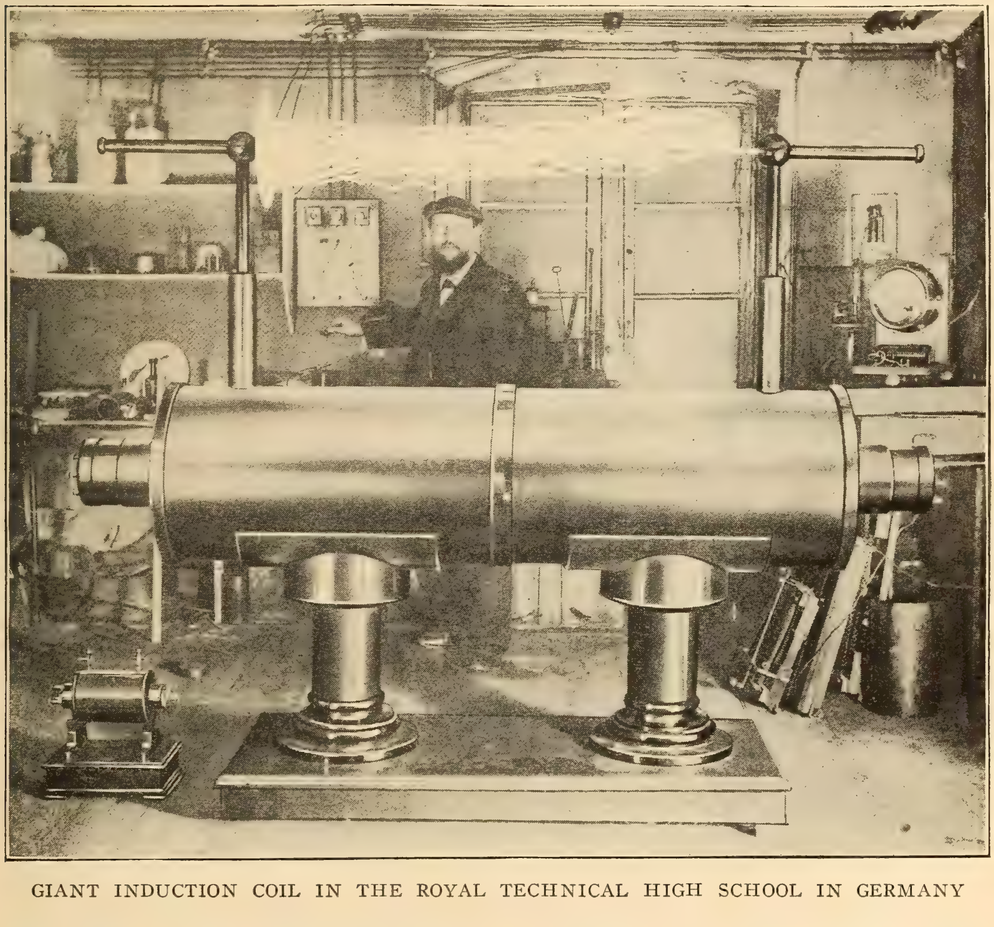
METHOD OF RODDING A CHIMNEY

In Kansas City was established the first central station using the Thomson-Houston system of electric lighting, and also one of the first stations employing the Edison system. In Kansas City was also established one of the first commercial electric street railways using the overhead trolley. The rolling stock consisted of two cars, each equipped with a 7½ horsepower, 250 volt, direct current motor.

A Giant Induction Coil

The great induction coil shown in the illustration is truly a giant not only in its outward appearance but in its construction and performance as well. That such a mammoth "inductorium" (as the Europeans term it) can be durably built is proved by the photograph, which shows the coil giving a rapid succession of sparks four feet long, and this after the coil had been in service for ten years. It was built for the Royal Technical High School of Vienna by the Swiss firm of Klingelfuss and Company, some features of the coil being designed by Prof. Carpentier of Paris. Our picture of it shows the sparks which passed between a positive point and a negative plate during a photographic exposure of one second. What these sparks mean in the way of high voltages can be readily imagined from the fact that 815,000 volts are required to make a spark jump through a distance of 40 inches, on the basis of investigations made by the builder of the coil.

The little coil down in the left hand corner, although it is capable of producing a five-inch spark, appears diminutive in comparison.



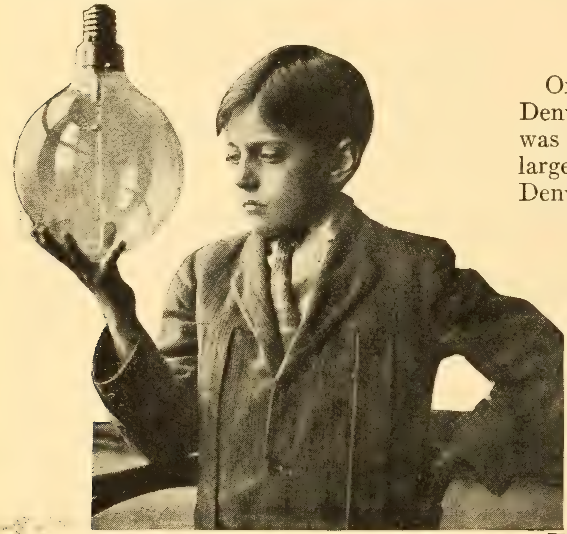
GIANT INDUCTION COIL IN THE ROYAL TECHNICAL HIGH SCHOOL IN GERMANY

Telephone Stations for Taxicabs

The Detroit Taxicab Company has contracted with the Home Telephone Company of Michigan, for sixteen branch stations similar to those used in the company's well known "wayside service," to be located on the two main thoroughfares. One station will be placed at the interesction of each mile circle. Drivers of cars will carry so-called "wayside type" of telephones, consisting of transmitter and receiver mounted on a light and durable handle inserted in a convenient leather case.

The Jumbo of Filament Lamps

We are fairly familiar with the amount of light an ordinary sixteen candle power lamp will give, but to have any definite mind picture of a filament lamp that gives 27 times that much light or 442 candlepower is out of the question. The accompanying illustration helps somewhat to give an idea of the size of a General Electric Mazda lamp of this type. The bulb is eight inches in diameter and over all 11¾ inches high.


A 442-CANDLEPOWER LAMP

The light from this lamp is steady and during the entire life of the lamp does not become poor in quality. As it requires no trimming it is adapted to lighting department stores, store fronts, billboards, and for the general illumination of large interiors such as auditoriums, armories, skating rinks, factories, yards and streets.

Making Insulation from Milk

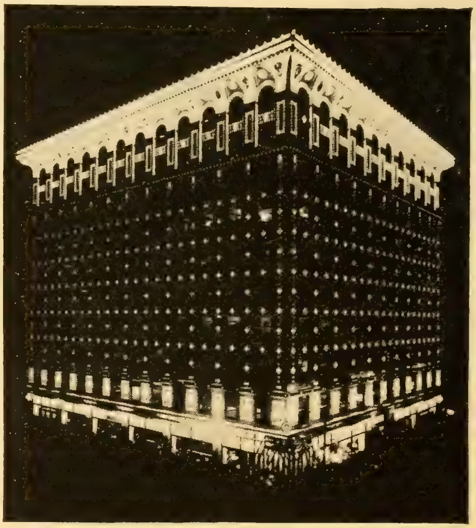
A Russian named Schuetze has invented a new process for making insulating pieces cut of milk curds. He stirs the curds into a paste with cold water, adding coloring material if a colored product is desired and heats them to the boiling point. After the paste has been boiled for some ten minutes, continued stirring reduces it to a uniform pulpy consistency. This pulp is taken while still hot to a hydraulic press fitted with hot molds of the shape in which the insulation pieces are wanted. After being pressed into this shape the pieces are cooled and dipped into formalin which adds the needed quality of a preservative. The product is said to resist the action of acids, to be much cheaper than hard rubber and to be easily colored in imitation of agate, marble or the like.

The Best Lighted Office Building in the World

By Joseph A. McMeel

On the evening of November 12th, the Denver Gas & Electric Company's building was illuminated for the first time. The largest crowd ever assembled on the streets of Denver turned out to see the initial illumination of the structure. The streets, roofs and windows in the vicinity were crowded. About 50,000 people jammed the thoroughfares as the time grew near for the turning on of the lights. Street car and vehicle traffic was suspended on Fifteenth Street, the railway company being forced to divert their traffic to Sixteenth Street where conditions were little better after the great throng had formed.

The building was decked in its splendor of light at 8 o'clock. About fifteen minutes before this time it was enveloped in darkness, this being done in order that the contrast might be shown more effectively. Mayor


DENVER GAS AND ELECTRIC COMPANY'S BUILDING AT NIGHT

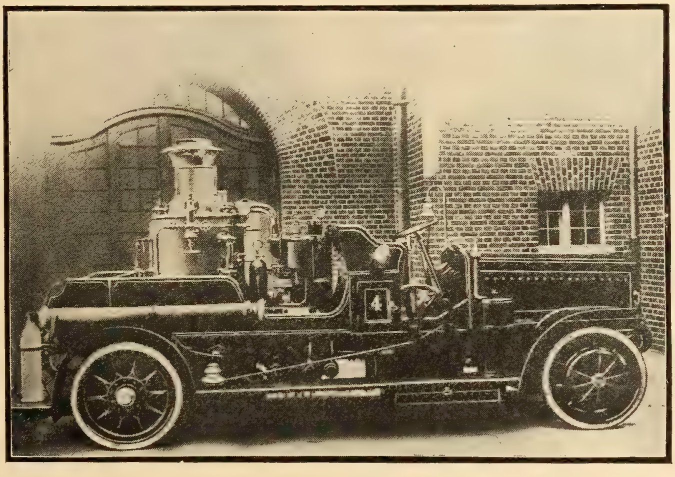
Speer and Frank W. Frueauff, General Manager of the Denver Gas and Electric company, mounted the platform on the Fifteenth and Champa street corner of the building, where was situated the enormous push button that the Mayor would push, a few minutes before the time set. Exactly at 8 o'clock the building burst forth in a brilliance that reflected to the heavens. A great roar went up from the multitude below as they witnessed the lightning of the best illuminated office building in the whole world.

It shines out like a gigantic jewel sparkling in the bright light of the sun. It dispels the darkness and does truly turn night into day. It is a tribute to the genius of the illuminating engineer. The piers of the structure are one mass of dazzling light. The second floor is a band of light forming a base for the field above. The tenth floor crowns the building. Over the windows sparkle huge diadems of light enclosed in crystal globes and above them is a cresting set with jewels of light like a king's crown.

It is the most palatial office structure in the entire West. Nothing in Denver can be compared with it. The main floor is decorated with the most expensive fixtures available. The floor is of solid cork. The counter tops and office enclosures are furnished in vitrolite. The piers and walls wainscotted ten feet high with glazed terra cotta all snowy white, make an impressive appearance. Imported African mahogany was used for the woodwork. Solid bronze fixtures weighing 100 pounds are suspended from a ceiling paneled with ornamental stucco designs that set off the interior in resplendent luxury.

On the main floor are situated the general offices and the private offices of General Superintendent W. J. Barker and Secretary C. N. Stannard. The second floor houses the bookkeeping room, the assembly room, some general offices and the offices of General Manager Frank W. Frueauff and J. T. Brady the treasurer. Three floors and the basement of the building are occupied bv the company.

A HORSELESS FIRE ENGINE



A HORSELESS FIRE ENGINE

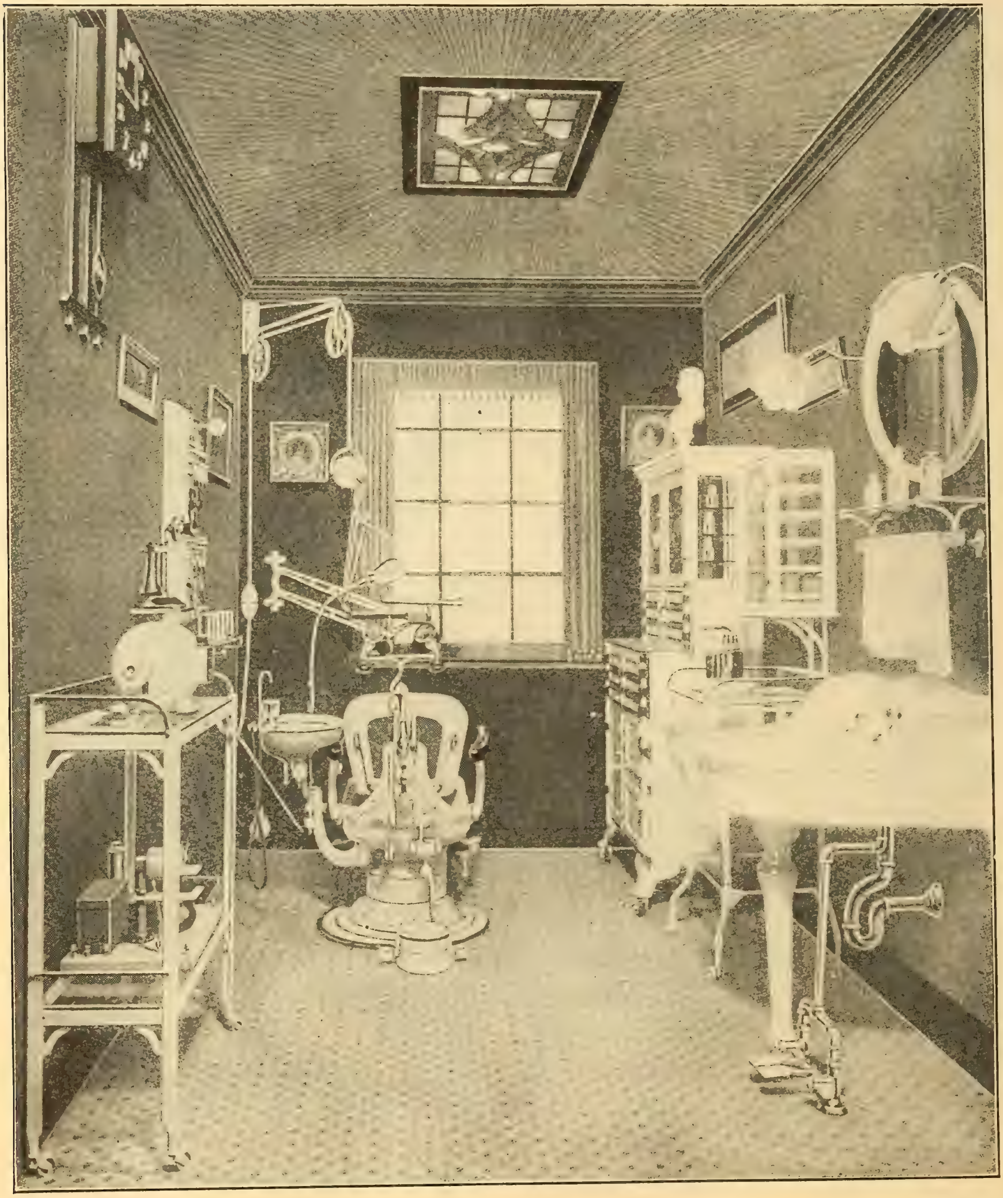
Ever since 1901, when fire engines mounted on automobiles were displayed at the International Exposition of Fire Fighting Appliances, those in charge of the fire department of the city of Berlin have been pioneers in the effort of eliminating horses from the service. Steam propelled engines have been tried, but they require a continual head of steam to be maintained in their boilers to insure an early start and this means a tremendous waste of fuel. Gasoline propulsion also involves delays and uncertainties in the starting, as clearly proven by the fact that German firms building gasoline fire engines mount them on vehicles propelled by storage batteries. For immediate starting in all kinds of weather and freedom from both repairs and adjustments, the use of electric motors supplied by storage batteries evidently has no equal. Hence Berlin is using electrically propelled fire fighting appliances of several different makes, our illustration showing one made at Bautzen.

The Modern Dentist

Schools and other public institutions are giving more and more attention to the matter of hygiene and along with this has come the physical examination of pupils in school which includes the condition of the teeth and recommendations as to their preservation and care. This means that the next generation at least will have much use for the dentist.

Electricity in the hands of the conscientious practitioner has wrought wonders in the medical field and it is doing as much in dentistry.

Next to the skill and care which your dentist exercises in relieving you of a fierce toothache or in saving a tooth by filling or crowning it, is the general appearance of his



A MODEL DENTAL OFFICE WHERE ELECTRICITY PREVAILS operating room as to cleanliness and modern equipment.

To demonstrate what can be done in this line the accompanying picture shows a Ritter model outfit. It not only looks clean but is clean, with white enameled stands and cabinets, plate glass shelves and electricity assisting. Of the electrical equipment, the engine by which work can be done in quick time is first. Then there is the switchboard from which low as well as high voltage instruments are operated.

From this switchboard may be operated a root canal dryer, an electric cautery for burning away tissue when necessary to cauterize, a hot air syringe for allaying toothache and drying out cavities in a much more effective manner than the old way of drawing the flame up into a syringe and putting it into the tooth. Also operated from the switchboard is an electric gold annealer for preparing gold and a mouth lamp. Then there is the electric sterilizer for boiling water in connection with the sterilization of the instruments, the electric spray-bottle heater which makes it possible to have warm solutions in the spray bottles and hot water in readiness all the time whether there is hot water in the office or not. The electric laboratory lathe is for polishing and grinding teeth and an electrically driven air pump supplies both the laboratory and the operating room with compressed air, at all times keeping the pressure at a uniform point. It is next to impossible for an up-to-date dentist to do without such an equipment or at least some parts of it.

The Magnetic Traction Fake

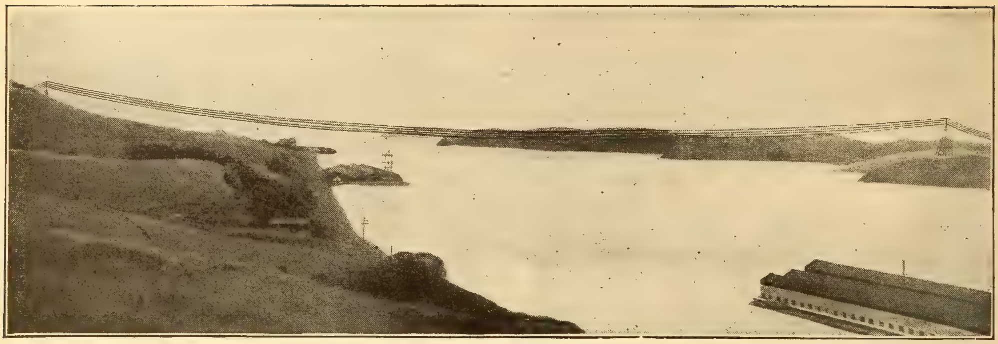
That "a little learning is a dangerous thing" is particularly true in the case of those whose slight knowledge of electrical and mechanical principles has led them to invest in fake schemes of which the magnetic traction brake is an example. Many of those whose money was ensnared by it have never understood just why the scheme would not work in practice. For, when a device is so simple that any person of average education can readily understand it and when a working model demonstrates it right before your own eyes, how could it fail to be commercially practical on a larger scale?

To demonstrate the system a miniature railroad track had been built with one end tilted at an incline far too steep for the little locomotive even when not pulling a load. Then by sending a current through coils wound on the axles of the locomotive, this could not only run up the steep grade alone but could also draw up a loaded car.

The model certainly worked like a charm. The underlying principles seemed too simple to involve practical difficulties on a larger scale and unquestionably such an increase in the tractive effect of the wheels on the rails would mean a decided improvement in railroad practice. Hence most of those who saw the demonstrations were easily convinced and many of them invested in stock of the company which was to put the exceedingly simple but promising invention on the market.

That was half a dozen or more years ago and still the railroads are not equipped with the loudly-heralded invention. Why is this, and indeed why should not some of the railroads or locomotive builders have monopolized the device instead of having it offered to the general public? Simply because it would not work in practice, for the reason that in building his model the promoter had cleverly, though inconspicuously, varied the proportions of the rails and cars from what they are in standard railroad construction. His idea of increasing the traction magnetically was correct enough in theory and in fact was old before he ever went to school; but the extent of this increase depends on the intensity of the magnetic circuit, i. e., the so-called magnetic flux through the rails, wheels and axles. The limit would be reached when the part having the smallest cross-section (which in practice is the rail) is saturated magnetically, so that the possible gain depends on the size of the rails. In the model the rails could be unusually large in proportion to the size of the wheels without attracting notice, for models are rarely well proportioned in all respects. If the same ratio employed in the model were followed out in the locomotives used on ordinary railroad work, the rails would have to be about two feet high and nearly a foot across the top. With such immense rails and with both axles and wheel flanges correspondingly increased, the plan should work in practice just as readily as it did in the model but such size would of course be out of the question.

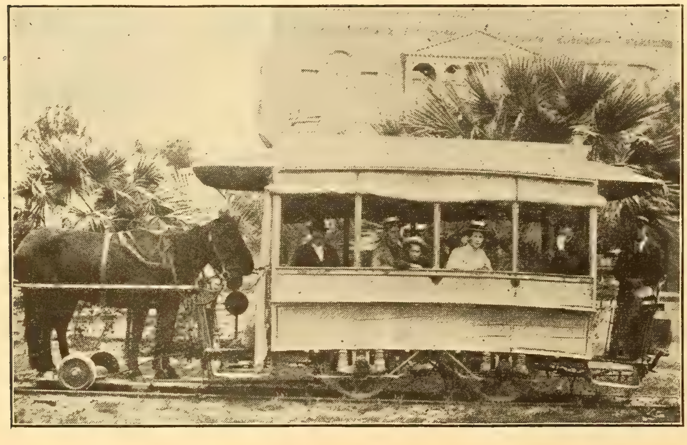
Albert Scheible.



This picture is a concrete example emphasizing the skill of the electrical engineer in overcoming the seemingly impossible problems in building miles and miles of high voltage lines in the West. This span of wires across the Carquinez Straits is 4427 feet (almost a mile) in length and is supported by strong steel towers on the banks. To lay heavy moisture-proof insulated cables on the bottom of the waterway or in a tunnel beneath would mean a heavy expense, so the Pacific Gas and Electric Company solved the problem in the manner shown.

Turn About is Fair Play

This picture shows, not what electricity is "doing," but what is has "done away with," and is a view of the former street railway equipment of Ontario, California. The track from the centre of Ontario to San Antonio Heights runs on a steady up grade for a distance of about seven miles. The transportation company economized the strength of its horses by a unique method. A truck was attached to the rear of the car and when the horses had pulled the little bobtail to the top of the grade the truck was placed in the rear the horses driven aboard and the car started on its downward journey by gravity, the horses riding with their heads over the back platform.



A MODE OF TRANSPORTATION THAT ELECTRICITY HAS DISPLACED

Like many other bits of picturesque western life this unique railroad has been modernized, and is now an up-to-date electric road.

C. L. Edholm.

Popularizing Electricity

A soft answer may turn away wrath but it takes hard facts to destroy it. How can an electric company expect to establish friendly relations with its patrons by tact and courtesy when the public knows so little about what they are buying? Confidence and ignorance are never chums. The first essential is to educate the layman, to introduce scientific terms into the vernacular so that the buyer and seller may speak in the same language.

That the layman is eager to learn is attested by the increased demand for books and articles on popular science. Yet the jokes in books are not half as funny as when told on the stage; so likewise it is necessary to talk directly to the people to make them understand how electricity is produced and what it will do. Just as the clown is the smartest man in the circus, so it requires the most brilliant minds to explain scientific matters simply. In these respects at least, science and humor are akin.

During the past summer a number of electrical manufacturers employed a college professor to roam around their works, just as does a "business doctor" who is sometimes called in to diagnose and prescribe for business failure. But this professor's mission was somewhat different. He simply talked with the men, encouraged them to ask questions and explained in simple language the scientific principles underlying the work they were doing. The companies considered the investment so good that they plan to repeat it at frequent intervals in the future. This professor possessed the rare faculty of popularizing science, of making technical matters clear to the common people. He taught the rudiments of a new language.

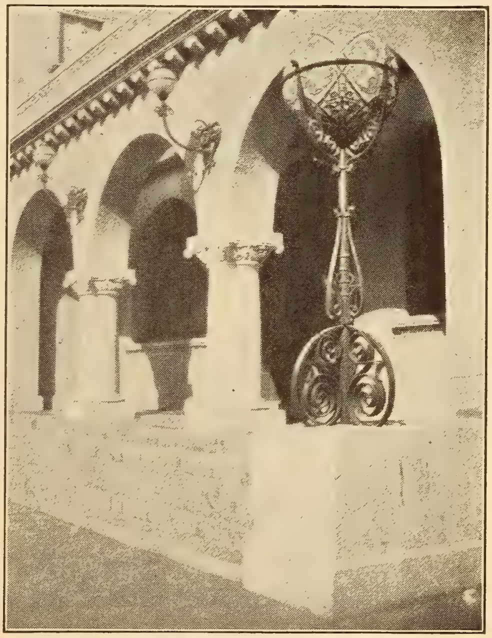
True it is that they learn only a sort of "pidgin" English, a makeshift that has little scientific use insomuch as what is gained by generalities is lost in definiteness. An English translation seldom does justice to a German original, for certain beauties of language are lost in the interpretation just as power is lost in transforming a high voltage current to one of lower potential. The petrographer uses a high power microscope to examine rocks but a cheap magnifying glass suffices for the prospector, giving a larger field but smaller resolving power. We do not use a thirteen inch gun to shoot rabbits, nor is it necessary that the layman be equipped with the ammunition of the scientist to gain a general knowledge of electricity. But if he be supplied with an elementary knowledge he can be brought to a sympathetic appreciation of the wonders of electricity and if he so desires may even use it as a sketeton key to unlock the more intricate subjects.—*Journal of Electricity, Power and Gas.*

Making Quartz Vessels

The intense heat which the mineral quartz is capable of standing, makes it unusually suitable as a material for retorts, crucibles and the like when these are to be used in chemical work requiring high temperatures. But if these quartz vessels themselves are to stand such high heats, how are they to be moulded? This problem has recently been solved in a novel and practical way by the manager of the Deutsche Quarzgesellschaft, Dr. Voelker. He packs beach sand (which is composed largely of quartz) around a carbon rod in the center of a carbon cylinder with a bore of about eight inches. Then he sends sufficient current through these carbon terminals to melt the sand and let the quartz form into a single tube weighing over a hundred pounds. This tube is drawn out of its carbon furnace with tongs while still hot and the hole in it is stuffed with either potatoes or lime, after which the tube is squeezed shut at each end. and the hot mass is put into moulds of the desired shape. Owing to the heat, the potatoes or lime generate considerable gas which presses the hot metal out against the sides of the mould. For cutting and finishing the quartz vessels when cold, Dr. Voelker uses both sandblast and saws fitted with teeth of carborundum, another product of the electric furnace. But the start in every case is obtained by melting the quartz crystals into a single mass in the intense heat of a simple electrical furnace.

Artistic Illumination

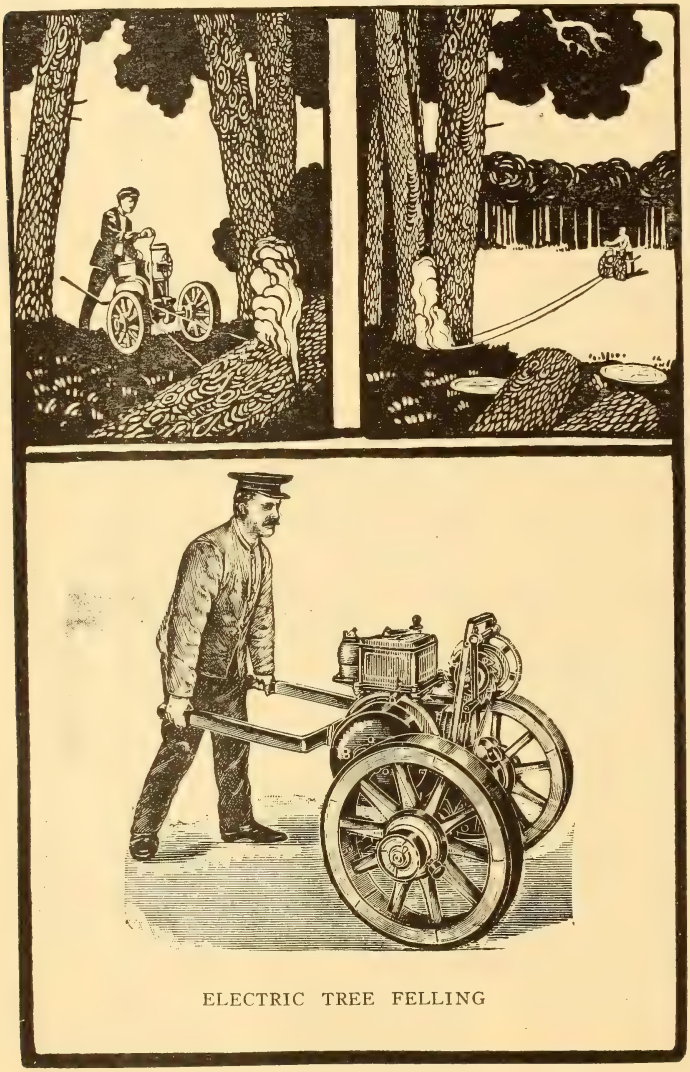
Probably as artistic an effect in electric illumination as one may have the opportunity of seeing is shown in the accompanying picture. The two lamps which are in the form of globes of stained glass are mounted upon frames of wrought iron and adorn either side of the entrance to the Carnegie library at Riverside, California.



ARTISTIC ILLUMINATION

Electric Tree Felling

The oft repeated suggestion that trees be felled by burning through the trunks with an electrically heated wire, while very pretty in theory, has not proven either feasible or economical in practice. It requires a wire of high resistance, which is not a cheap article, particularly in the lengths needed for the trunks of large trees. However, that was only one way of attacking the problem electrically and already another solution has been developed by a German manufacturer (Hugo Gantke), which seems much more practical and economical.



ELECTRIC TREE FELLING

The new method uses a fine steel wire which is wrapped partly around the stem and is pulled back and forth by cables attached to an electric motor-driven drum. The friction of the wire which is moved to and fro 1,500 times per minute, heats it red hot so that it literally burns its way through the trunk in half the time it would take two men to saw down the tree. In doing so, the heat carbonizes the severed ends, leaving them protected against easy rotting in case they are left on the ground for some time. If the tree is to fall in a certain direction, this can be insured by notching the trunk with an axe. However, time is usually saved by simply placing the motor at a safe distance (100 to 150 feet) and letting the tree fall wherever it will. A new steel wire is used for each cut, the cost in Germany ranging from one-fifth to one-half cent each, according to the length and nature of the wood, which is less than the cost of filing and setting saws or of sharpening axes for the same work. Besides, the cutting can be done flush with the soil, or as much below ground as the root structure will permit, thereby saving the work of grubbing in many cases.

The motor equipment is mounted on a two-wheeled cart and as it weighs only 570 pounds, it can easily be managed by one man even for trees measuring as much as ten feet in diameter.

Where no source of electric current is available close to the forest, this can be supplied by a portable gasoline and dynamo outfit from which the current is led to the sawing motor by a flexible cable.

A Diver's Electric Lantern

A curious situation arises when it comes to designing an electric lamp for the use of divers. The under-water man does not wish to be hampered by having to drag around a conducting cable from the boat above. To him the storage battery lamp appeals as the most adaptable, and the very thing which makes such an outfit prohibitive on the surface, the weight, is a distinct advantage when under water. It helps to keep the diver down.

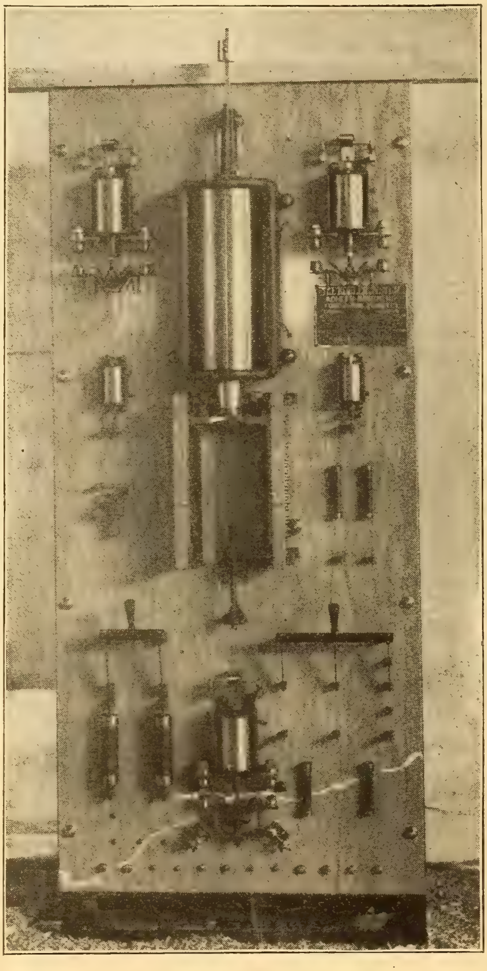
For this purpose the casing which houses the battery and lamps, as well as the glass front, are heavily built to withstand both bumping and the pressure of the water. The result is a combination which it would tax a man to carry with him while on deck but which makes a desirable weight for helping to keep the diver far below the surface. In using it, the outfit is strapped to the diver's breast by chains hooked into ears at each side of the casing, so that the light shines steadily in front of him while he is free to use both arms.

ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

A Switchboard that "Thinks"

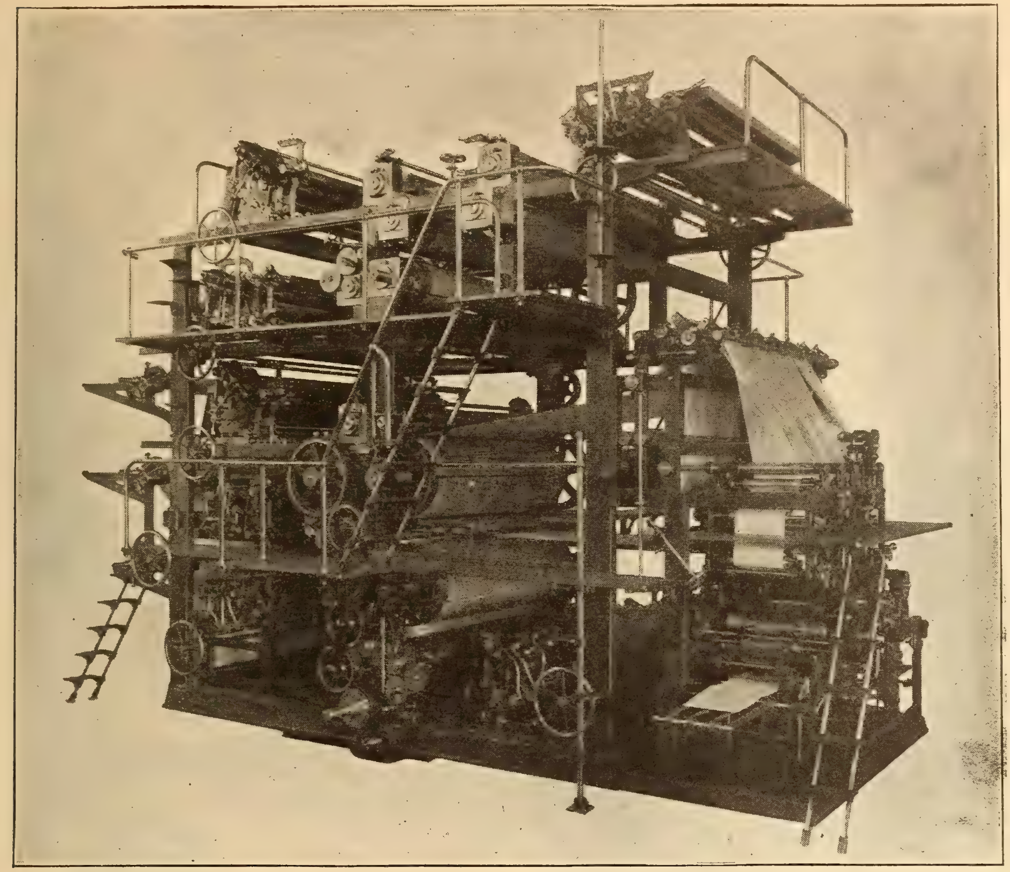
By C. B. EDWARDS



THE SWITCHBOARD THAT "THINKS"

Since the perfection of the telephone and telegraph perhaps no single invention has influenced rapid magazine and newspaper printing more than the electric press control. Few indeed are they who have not wondered at the motorman on a car who controls accurately the speed from the manipulation of the controller handle. But far more wonderful than this, the electric control on the modern magazine press allows of speed in infinitely finer gradations from the turn of scarcely more than a hair's breadth of the great printing rollers to a speed which sends 80-paged magazines on the delivery webs in bewildering profusion. The almost incredible part of it all is that the man who is controlling the machine is not standing in front of a great marble switchboard or even with his hand on a controller handle, but when he desires a higher speed, say of a thousand more issues an hour, he reaches up and touches one of five buttons much the same as you would ring your doorbell. The great press instantly responds and when the delivery man at the output end perceives that the counter records the required increase he so notifies the pressman who is still holding his finger on the button and he removes it.

Located about the press at eight different points or stations are found press button switches scarcely larger than the switches on the wall that control the lighting of a chandelier. Instead of having two pushes, however, each of the eight stations has three buttons in the top row labeled "on," "stop" and "off" and in the lower portion of the same plate are located two smaller buttons with "run" under one and "safe" under the other. In connection with this control two motors are required on account of the great starting load and the desirability of slow speed for adjusting the plates before the run is commenced.



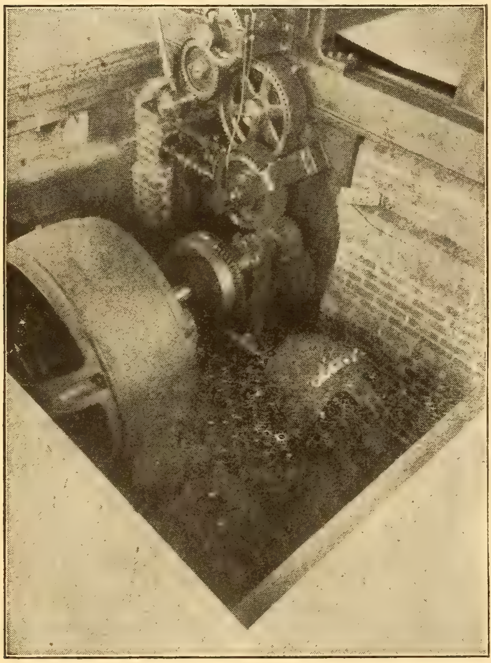
A MODERN MAGAZINE PRESS THAT DELIVERS COMPLETE 80-PAGE MAGAZINES AT THE RATE OF 9,000 PER HOUR

One motor of 7½ horse power, connected to a worm gear and giving a reduction of 25 to 1, starts the press and when it reaches its speed limit the other 50 horse power motor lifts the load from the smaller machine and brings the press to running speed, which may vary from seven to nine thousand 80-page magazines per hour.

The push button control practically thinks for the man who starts the press and relieves him of the responsibility, to a great extent, of being held liable for the damage of the tons of costly machinery placed in his care. Before the automatic push button control was invented an ordinary controlling rheostat was used in starting up and it was "up" to the man holding the controller handle to see that he did not cut out his resistance too fast and strip the driving gears or start the press while some of the pressmen were endeavoring to tighten a stereotype plate. In the use of the push button control it is practically impossible for such accidents to happen, for by merely pushing the "safe" button on the nearest station the pressman goes on safely with his adjusting and tinkering and it is impossible for anyone else to start the press from any other station till he has pressed the other lower button marked "run" at his station.

It is likewise provided for that no gears shall be stripped, for the solenoid shown in the center of the photograph of the board that "thinks" moves so slowly when the start button is pushed and cuts out the resistance of the motor starter and brings the motor up to speed so gradually that a large factor of safety intervenes to prevent the stripping of a single tooth.

Essentially the whole device depends upon the attraction of an iron core which is movable up and down inside of a solenoid located in the center of the switchboard. In operation when the "on" button is pressed a current energizes a ratchet dog magnet, the dog is pulled away and the iron core, which is full up in the solenoid when the press is still, starts downward by gravitation. An oil dash pot keeps the plunger attached to the iron core from descending at a rapid rate and as the plunger descends it makes successive contacts with the terminals located in the exact center of the board, which first throw the main switch to the small motor and then cut out the resistance till it approaches its highest speed. When this is reached the still descending plunger breaks the main switch of the small motor and throws in the main switch of the large motor and then the starting resistance of the latter is gradually cut out again till running speed is reached.



MOTOR WHICH DRIVES A MODERN MAGAZINE PRESS

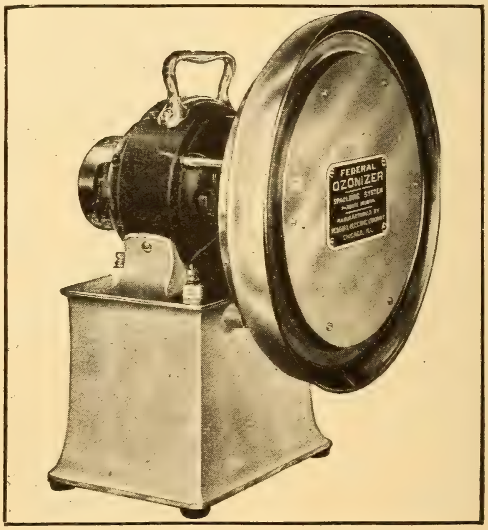
All the time that the press is accelerating its speed from the time the button under the "on" is first pressed the button must be held down until the desired speed is reached or the dog will re-engage the ratchet on the plunger and hold it there. When the desired speed is reached the button is released and the press remains running at that speed. To slow down or stop after the run is over the "off" button is pressed and a "relay" coil on the switchboard is energized, allowing current to travel through the large solenoid; the core is attracted and the operation described under the starting of the press is reversed as long as the button is depressed. In case of an emergency the center "stop" button is pushed and through the lowest solenoid switch on the board all of the current is automatically switched off and a dynamic brake applied which is positively and absolutely regulated through an adjustable resistance to meet every condition.

It is therefore seen that from any one of the eight stations situated about the press the finest variations in speed and the quickest stopping are under the positive and instant control of any one of the pressmen.

The photographs reproduced herewith show a typical magazine press of the most recent type, its drives and motor, and the controlling board.

Portable Ozone Machine

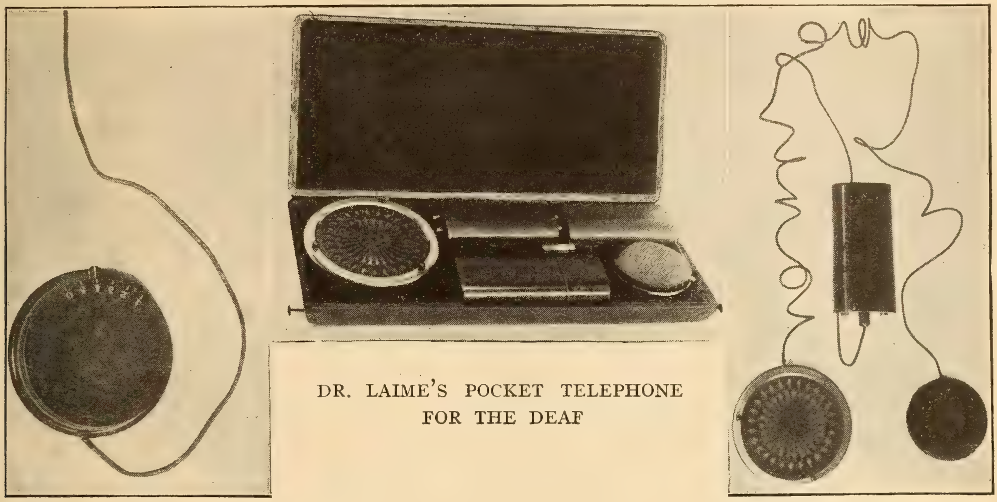
A new comer among the various types of ozone machines is designed to meet the demands for a small and portable generator. It is made of polished aluminum with the exception of the motor case which is black enamel. With the transformer in the base and a convenient handle on the top it affords a most compact and convenient machine for office and home use, connection being made by a plug and cord to any electric light socket.



PORTABLE OZONE MACHINE

Aid to the Deaf

A French inventor, Doctor Laimé, has devised an aid to deaf people somewhat similar to the electrophone and the acousticon now quite commonly used in this country. As in the case of the two systems mentioned it consists of a compact battery, a transmitter and a watch-shaped receiver to be held to the ear. In fact it is a very compact telephone system so small as to be packed complete in a pocket case.



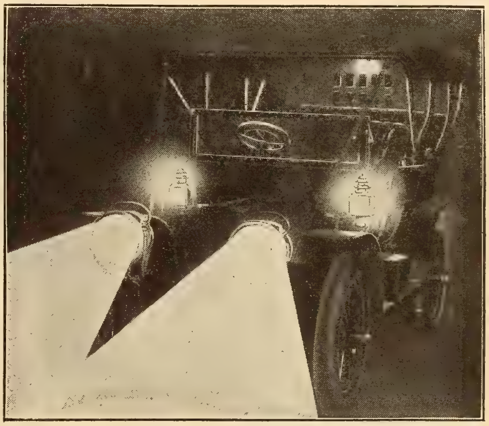
DR. LAIME'S POCKET TELEPHONE FOR THE DEAF

The transmitter which receives the sounds is circular in shape and can be carried in the pocket or laid on a table. It is connected by flexible conductors to the battery and to the receiver. The sounds are taken up by the transmitter and intensified in the receiver so that people who are not absolutely deaf are able in many cases to hear quite clearly.

The receiver is held close to the ear, like an ordinary telephone receiver, being kept in position by a spring whenever both hands have to be disengaged. This part comprises a special device for controlling the sensitiveness of the apparatus which enables the latter to be adapted to the degree of deafness of the patient, thus avoiding any hurt due to excessive sound intensities. This regulating device is a variable resistance controlled by a small handle shifted along the five divisions of a dial. Each of these divisions corresponds to a given sound intensity, whereas in a sixth position (designated "O") the current is broken.

An Auto Electric Lighting Plant

Motoring will always be considered a daylight sport, but night lends many advantages and pleasures to this form of recreation through the development of a device by which a light almost duplicating daylight is shed upon the road stretching before the speeding car making travel safe, and relieving the strain felt by every motorist on account of imperfect roads and inefficient light.



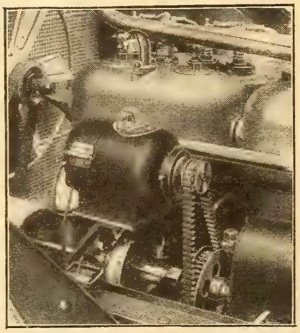
THE LIGHTS IN FULL BLAST

An outfit is now in use by which electric current for lighting the lamps, is generated by the car itself. It consists of a small multipolar dynamo weighing 24 pounds and having a positive drive from the engine of the automobile. And in addition to this there is a storage battery.

The dynamo is so constructed that even on a slow speed it produces sufficient current to light all the lamps brilliantly. It is controlled by what is known as a load-regulator, so that when the car is speeding or the engine running "wild" only the proper amount of current is supplied to the lamps.

The storage battery is so connected that it is charged while running and maintains the lights when the engine is at rest. The lamps are all controlled from the seat of the chauffeur, making it unnecessary to leave the car either to light or extinguish the lamps. The headlights may be fitted with 20-candle-power tungsten lamps, while the side, dash and tail lights use the four-candle-power lamps.

The illustrations show a touring car with lamps going at full blast; also the interior of the engine bonnet showing the dynamo attached to the engine. The apparatus is so constructed that it can be adapted to any make of car.



AUTOMOBILE ELECTRIC POWER PLANT

FOR THE MAN WITH A STORAGE BATTERY

Every battery man knows that the condition of a cell can be very closely determined by finding its voltage with a low reading voltmeter.

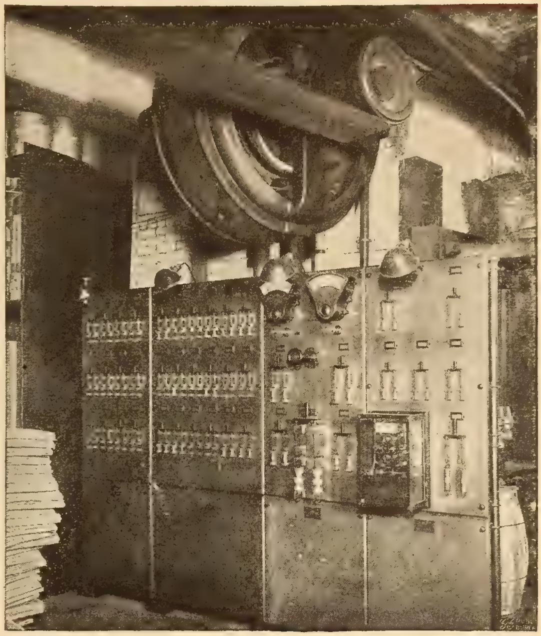
The illustration shows the Electric Storage Battery Company's pocket voltmeter being used to check up the cells of an electric truck. The instrument is heavily nickel plated and when enclosed in its aluminum case, $3\frac{1}{8}$ by $3\frac{1}{8}$ by 1 inch, weighs only eleven ounces. The scale reads from 0.2 volt to 2.8 volts and is furnished with a silk-covered contact cord and nickel plated terminal contact points.

The next piece of apparatus to have at hand in caring for a storage battery is some sort of a gravity tester. The syringe type is very convenient and is operated by pressing the air out of the rubber bulb and allowing the electrolyte to enter the glass compartment where its specific gravity is read on the hydrometer.

USING THE POCKET VOLTMETER

Electricity in Book Making

A soiled book or magazine is always shoved aside for one well bound and clean. Cleanliness as well as despatch is imperative in a bookbindery where hundreds of sheets of printed matter must be folded, bound and kept spotless. Overhead shafting with its bearings and belts cause loss of production from falling oil and grit, but electric drive is able to remedy this and give at the same time economical operation as is attested at the plant of the Williams Bookbinding Company, New York City, recently equipped with 35 General Electric motors varying in size from one-fourth to five horse-power.

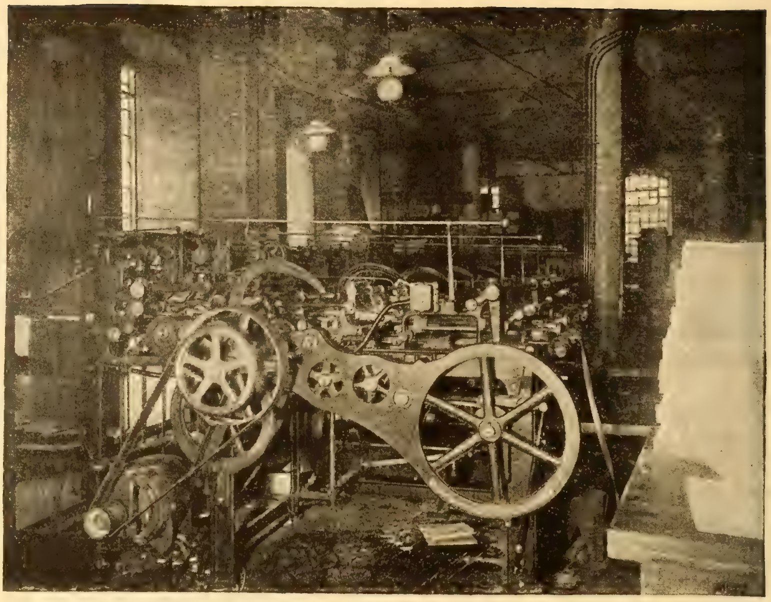


THE DYNAMO AND SWITCHBOARD IN A MODERN BOOK BINDERY. NOTE THAT THE DYNAMO IS MOUNTED ON THE CEILING

The installation as is seen by the illustrations is an economizer of space, even the generator, which is driven by a slow speed Corliss engine, being located on the ceiling. The folding machines which pick up the large sheets of printed paper and wrap them up one fold after another until they reach the page size of the book or magazine of which they are to become a part, are equipped with two-button push-button stations located at six different points about each machine so that in case anything goes wrong the machines may be quickly stopped by pushing the nearest button.

IN THE VARIOUS SMALLER OPERATIONS MOTOR-DRIVE MACHINERY IS USED EXCLUSIVELY

The paper cutter is shown in operation while the pasting machine, a piece of apparatus which it was thought impossible to run by a motor because it must stop very quickly, was made manageable for a girl attendant by a starter and brake controlled entirely



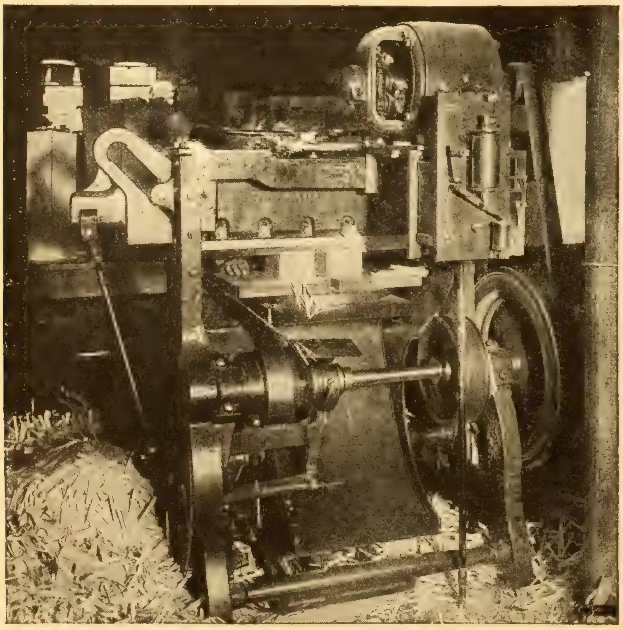
SIX DEXTER FOLDERS FITTED WITH MECHANICAL FEEDERS AND DRIVEN BY ELECTRICITY

by a push button.

The machine which rounds up the back of a book finishes from 30 to 90 books an hour according to weight, size and material.

A very interesting machine is that which, from its use, is known as the "gatherer." A book is usually made up of sections which will ordinarily vary in number from 25 to 60. It is the purpose of this machine to gather these sections in proper order so that when delivered the pages read consecutively. The starter for this gatherer is mounted on the far wall in the picture, the operating buttons being located on the machine at the receiving end. The motor is mounted on pipe supports out of the way. Nearly all motors larger than one horsepower are provided with automatic starting devices, the result of which is an increase of 15 per cent in the output for a given number of men and machines. This increase in production has not been due alone to the speeding up of various machines, but to the time saved through not having the employees concerned with starting the motors.

At first, when hand operated rheostats were used, the girl attendants would pull away from a rheostat handle when a spark occurred, several attempts usually being made before the lever was finally set on the holding coil. The male attendants, on the other hand, would hold the handle on a point until smoke came from the rheostat, when they would let the handle go and wait for the rheostat to cool. It was to eliminate these losses that the company installed automatic starting devices and the results have more than justified the expenditure.



A MOTOR-DRIVEN PAPER CUTTER

Electrically Hardened Stairs

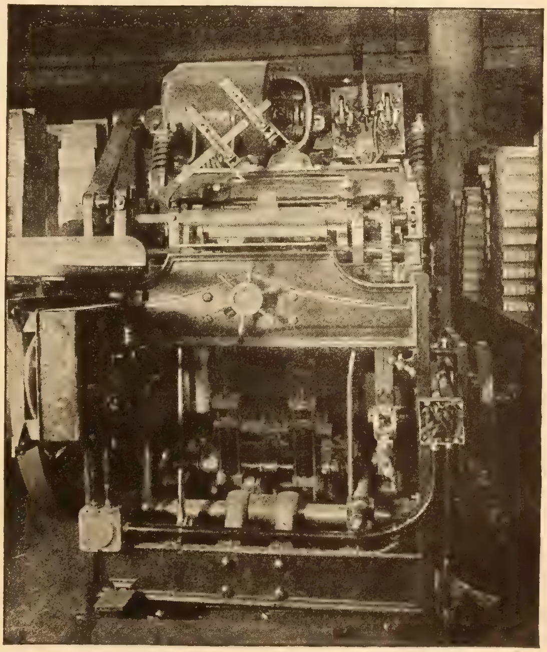
The maintenance of stairs has long been a serious problem in large city depots and in other public places where the large number of persons tramping on the same wear them out rapidly. Even as hard a material as granite soon has its rough surface rendered slippery and quickly wears away. Now one of the hardest products of the electric furnace has come to the rescue, it being carborundum, the crystals of which are almost as hard as a diamond. When mixed with the ingredients of ordinary concrete this makes a stone so much harder than the shoe soles as to easily resist their wear. Trials at the Paris subway after an estimated traffic of over 14,000,000 persons showed no appreciable wear on these carborundum-concrete stairs. Besides they are reported to be remarkably noiseless for cement stairs, which makes them all the more pleasing.

THE ALMOST HUMAN GATHERING MACHINE

The city of Tokyo, Japan, is soon to be provided with an electric elevated railway. The line will be supported on brick arches at an elevation of twenty-two feet above the street, and the estimated cost is $13,500,000.

A Quarter of a Million Miles of Cable

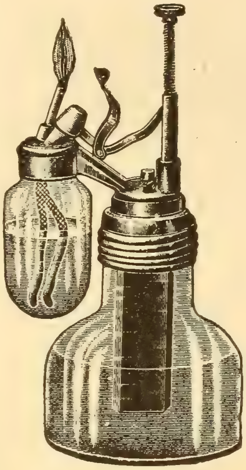
There are about 225,000 miles of cable in all at the bottom of the sea, representing $250,000,000, each line costing about $1,000 a mile to make and lay. The average useful life of a cable nowadays is anything between thirty and forty years, according to circumstances. About 6,000,000 messages are conveyed by the world's cables throughout the year, or 15,000 a day, the working speed being up to 100 words a minute under present conditions. About 90 per cent of these are sent in code or cipher.



THE ROUNDER AND BACKER WHICH PREPARES AND GLUES THE EDGES OF A BOOK BEFORE BINDING

A Curious Cigar Lighter

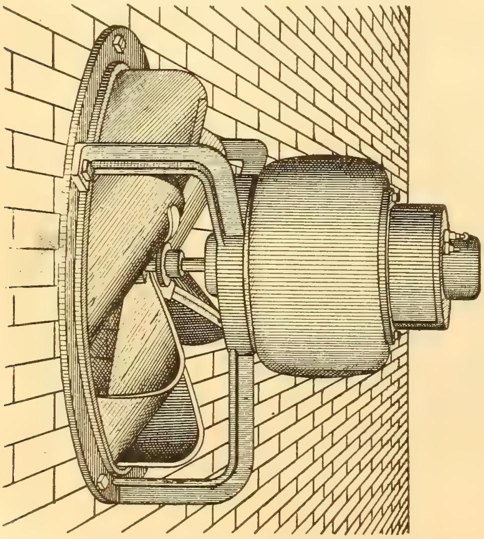
If any slogan were needed for expressing the feeling that has lately been prompting many inventions in Germany, it might be: "Anything to beat the match tax!" Where current is available, electric cigar lighters have found a ready sale and even where there is no wiring, the demand for such lighters has been strongly felt. To meet it, one firm is putting out a primary battery of the familiar bichromate of potash and sulphuric acid type, with a little alcohol lamp supported by it. Depressing the zinc uncaps the wick and gives a spark to light it, while a spring slowly draws the zinc out of the solution and snuffs out the wick.



CIGAR LIGHTER

Ventilation Easily Controlled

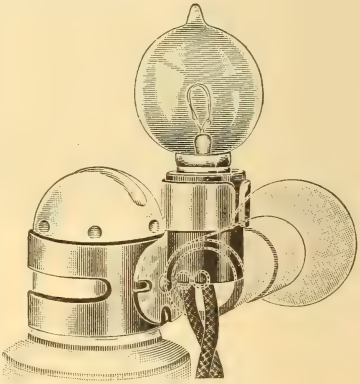
When one is seated in a cool, comfortable theatre waiting for the curtain to go up, it is quite easy to give no thought as to how this condition of the air is attained. The accompanying illustration reveals one means in the ventilating fan operated by an electric motor secured to the wall. The device takes up and forces out the foul air. This method of forced ventilation can be and is used also in both large and small restaurants. One of the features of the illustration is the fact that during the periods when many people are to be cared for the fan may be run at full speed, while during the lax or closed hours the system may be run at slow speed or shut down entirely by the simple adjustment of a lever or the throwing of a switch.



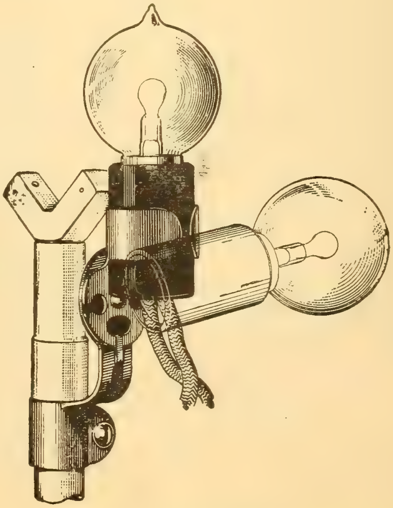
MOTOR-DRIVEN VENTILATOR

Converting Oil or Gas Lamps to Electric

The automobilist who wishes to light his machine with electric lamps and at the same time retain his oil or gas burners for emergency use will find the Gil-Bo lamp brackets here illustrated very suitable for the purpose. On either type the electric bulb is easily turned out of the way when the oil or gas burner is lighted.



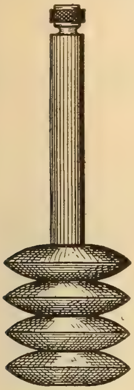
FOR OIL BURNER



FOR GAS BURNER

New Method of Grounding

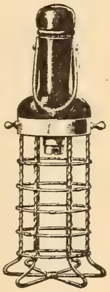
The question of how to provide a ground in electrical construction so that it will be permanent is the subject of much discussion. The illustration shows one method, the Lord hydroground. This consists of several ovoids which are made of a composition which is absorbent, non-metallic, and not affected by acids. A galvanized iron pipe runs down through the ovoids, this pipe being covered on the outside with cotton hose saturated with asphaltum. The hydroground is buried at least six feet in the ground and a pail or so of strong salt water thrown over it after the ground wire is connected to it by a lug provided.



HYDRO-GROUND

An English Hand Lamp

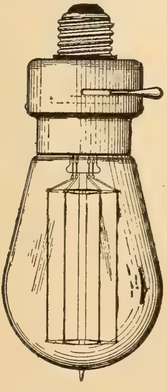
While in America we refer to an electric light arranged to be carried about, as a "portable lamp," our English cousins call it a "hand lamp." Such a device if made in accordance with Underwriters' rules in this country and as prescribed by the Board of Trade in England must be protected by a wire guard of which there are many styles. The one illustrated is of English manufacture. It is constructed with a handle and a base so that it may be set down upon any flat surface like a lantern.



AN ENGLISH HAND LAMP

Lamp with Three Degrees of Light

A patent has been issued to Delo Hoke Bering, Pittsburgh, Pennsylvania, on an invention for increasing or diminishing the light given by an incandescent lamp by the movement of a switch shown in the illustration in the base of the lamp. The lamp is provided with two single filaments and two sets of double filaments. Moving the switch to the first contact places a single filament in circuit for a night lamp. Contact two brings the second single filament into use. The next two advancements of the switch connect filaments until all six are aglow.

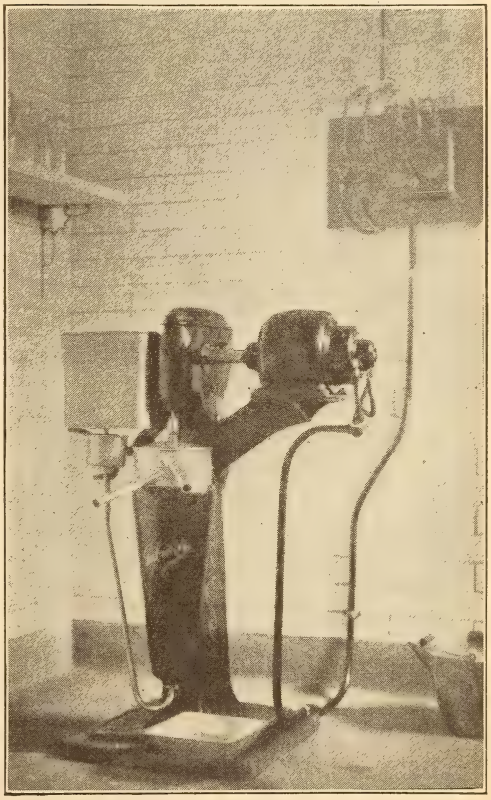


LAMP WITH SEVERAL FILAMENTS

Motor Skims the Milk

Cleanliness is the watchword in modern dairies, processes and apparatus being sought which afford the greatest improvement in this direction.

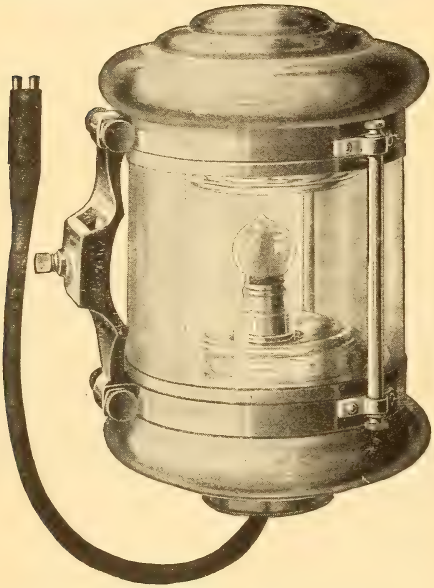
Because of its cleanly qualities the electric motor is conceded first place as a means of power for operating cream separators, ice cream freezers and similar machinery. Mounted on a pedestal of metal arranged to support it the motor is shown in the picture operating a tubular cream separato on the same metal base.



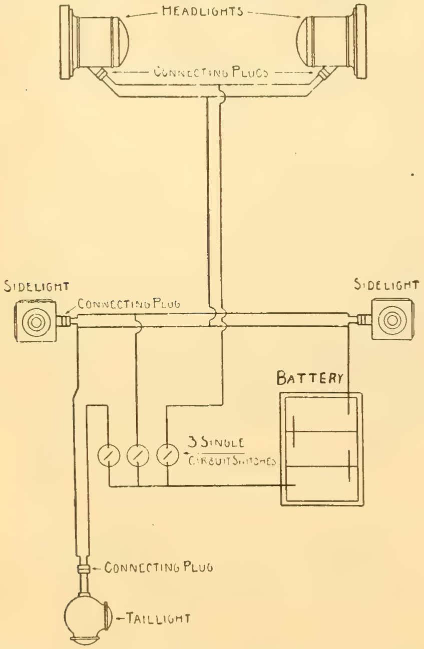
TUBULAR CREAM SEPARATOR, MOTOR OPERATED

Electric Automobile Lights

The cylindrical "Hyray" electric side light shown in the accompanying cut is a new design for the lighting of motor cars. For ordinary purposes it is equipped with a two or four candlepower tungsten lamp. The cylinder of glass which forms the sides is $4\frac{1}{2}$ inches in diameter and $3\frac{3}{4}$ inches high.



ELECTRIC SIDE LIGHT FOR AUTOMOBILES

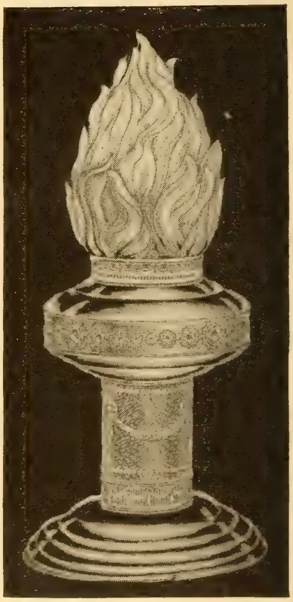


WIRING FOR AUTOMOBILE HEAD LIGHTS

There is also manufactured by the same company an electric fitting for headlights which can be adapted to the ordinary cylindrical gas lamp or "flare front" lamp, making it possible to convert from gas to electric lighting. The method of wiring is shown.

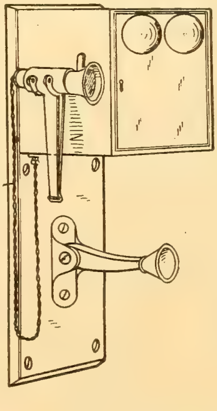
Torches for Show Windows

The never-ending fascination of watching the color play of a flame would lend itself readily to show window displays, were it not for the fire risk introduced by any real flames. To reproduce this catchy effect without its danger, a German firm is offering electric fire urns with opalescent glass globes moulded in the shape of flames. Within each globe are a number of miniature lamps of various colors, some of which burn continuously, while others are lit in rapid succession.



AN ELECTRIC TORCH

Telephone Receiver Handle



TELEPHONE RECEIVER HANDLE

The object of the invention here illustrated is to provide a convenient, light, cheap and readily attachable handle for telephone receivers. The handle is so made that when the receiver is not in use the hook supports the handle and the handle, the receiver. The patent is issued to Chas. A. Barnes, Sr., Greenfield, Indiana.

FOR PRACTICAL ELECTRICAL WORKERS

HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

The Romance of Power

By WARREN H. MILLER

II.—SUPERHEATED STEAM UNITS

I suppose that in 100 years from now our great-great-grandchildren will look back on this era with pitying wonder, not unmixed with rage at the clumsy manner in which we dug into the priceless stores of the world's combustibles. No other century in the world's history has seen such prodigious wastes. Our descendants will fume at the way we went through the stored energy of millions of years in a single century,—how we threw away nine times as much coal to get out a single horsepower of work as was necessary, and how we used 30 times as much power for a single candle-power of light as Nature does with her glowworms and fireflies. *They* will probably have the glowworm's secret by that time, and will use steam so as to convert from coal to power with about the same efficiency as our dynamos, but meanwhile *we* will have used up all the coal, so the world will be little better off for all those improvements.

We may think that we now understand electricity pretty well, but, just for instance,—can anyone on earth explain the battery of the electric eel, and how he succeeds in directing a shock through three or four feet of a universal conductor like salt water? You perceive that there *is* still a good deal about electric power and its transmission that we do not understand, for that shock has force enough to kill a horse.

One hundred years ago Watt built the first steam engine. From a coal-using point of view it was surprisingly economical, since our present-day small dynamo engines use twice as much coal for the same power. During these hundred years we have not done much to save coal, but have been rather perfecting the mechanical side of the engine, so as to get lots of power out of a comparatively small mechanism of iron and steel, until there is virtually no greater mechanical perfection obtainable. And now, with the opening years of the Twentieth Century, the scientific-minded Germans are turning their thoughts in advance from mere mechanical perfection into a consideration of the whole question of steam power from coal, taking the fire, boiler, steam and engine as a single unit.

Let us study our ordinary modern steam plant as such a unit and see if a few criticisms cannot be made. In the first place Science tells us that the engine is using a great deal too much steam. During the exhaust stroke the cylinder-walls cool down to the temperature of the condenser, and when steam is again admitted a lot of it condenses on the walls in heating them up again. This condensed steam passes out to the condenser with the next exhaust, doing no work, and this waste is not less than a third of all the steam used in the engine. So the engine could be one-third smaller for the same power, that is use a third less steam, and, if so, the boiler could be *more* than a third smaller, say one-half the size, because the boiler introduces its own losses in making the steam.

Criticism No. 2. Twenty per cent of all the heat in the coal goes up the stack. That's quite a loss, for it is not necessary to waste twice as much energy as the engine itself delivers (ten per cent) in simply creating chimney draught. Better use a small fan than that. But these stack gases *are* wasted, mostly because their temperature is too low to use them on the steam.

Then our plant seems entirely too much spread around. There is a boiler in one room and an engine in another and a lot of piping in between, with still more piping to run a couple of little steam feed-pumps, which use up four times as much steam to the horsepower as the big engine does. Evidently the whole question of what we are going to do with our coal needs reconsideration, because this piping wastes by radiation five per cent of all the steam made, the boiler shell wastes another five per cent, and finally the grate wastes another five per cent in direct radiation from the under side of the grate into the ash pit.

All this is when the plant is new. As it gets old and the boiler gets scaly in spite of all our efforts to clean it, all these losses increase several per cent each until we take *five times* as much coal to make a horsepower as the Germans do with some of their new and more scientific steam units.

For theirs *is* a unit—a compact machine for taking literally a pound of coal and delivering from it a horsepower. Let's see how they do it. Science tells us that the way to get rid of cylinder condensation is to superheat the steam. If the engine is compound condensing, superheat for *both* cylinders, or else you will lose again in the low pressure cylinder just as we do in ordinary compound engines. Science says that 587° F. is hot enough, so that the steam will still be sufficiently hot when exhausting not to condense. To get this temperature we must shorten up the boiler tubes, thus decreasing the amount of water evaporated, but that is just what we want, since the engine will not need so much steam to yield the same horsepower in mechanical work.

As the engine will be compound, so as to get down to condenser temperature without wasting any heat in the steam, it is necessary to re-superheat before admitting the exhaust of the high into the low. Science shows that 360° F. is enough for the second cylinder, so we have here a use for the low-temperature stack-gases that are usually thrown away up the chimney.

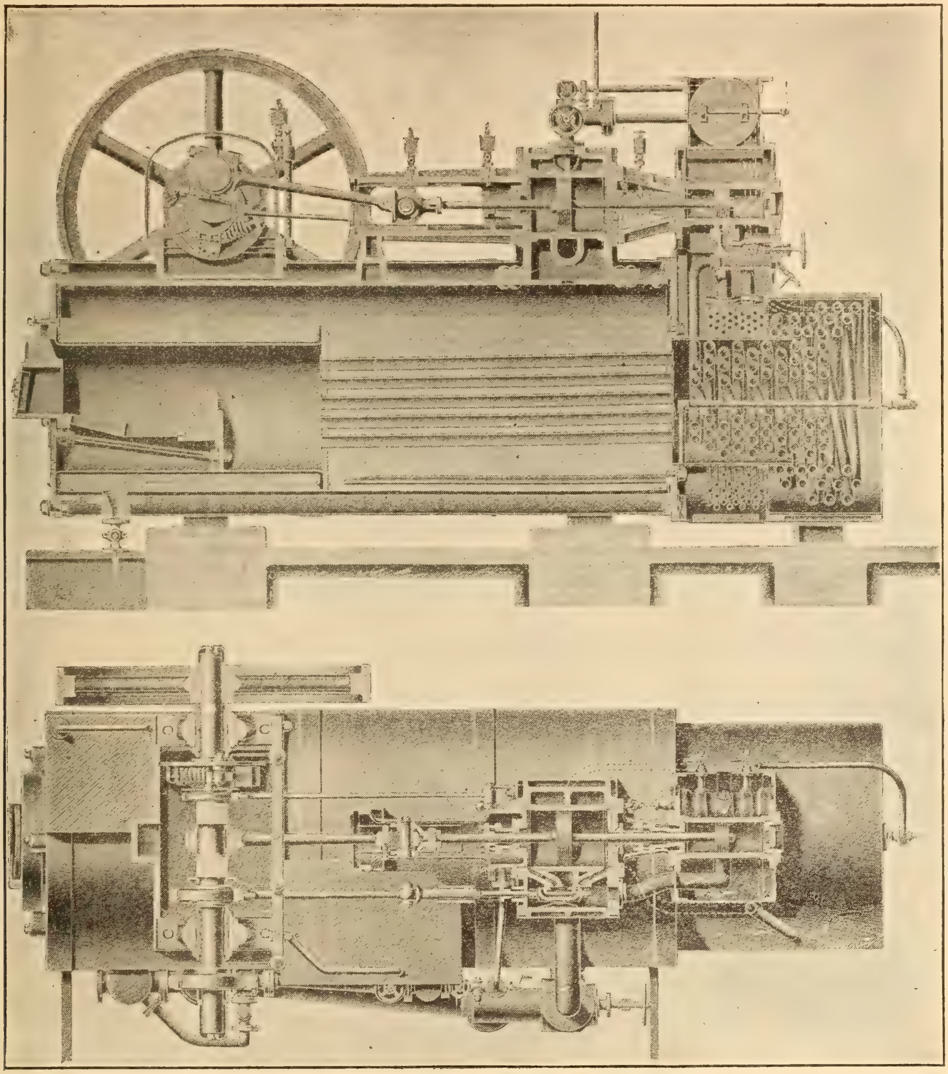
But after exhausting from the low, the steam will now arrive at the condenser too hot, so it had better be passed through a feed water heater and then to the condenser thus using up all the rest of its heat.

Now let us see what can be done with the radiation losses. Suppose we mount the engine right on the boiler. Then we have no steam piping at all, as we can go direct from the first superheater into the high pressure cylinder, right back into the second superheater and back again into the low. Then we can surround the boiler with an airtight Russia-iron shell, making it practically impervious to heat. Again, the cylinders themselves radiate about two per cent of the steam heat, being merely lagged with asbestos and fancy cast iron. Let's lag them with steam or hot gases, by mounting one cylinder in the steam-dome, or rather casting it in one piece with the dome, and mount the other in the chimney. Then the radiation will be *into* the cylinders, not out of them. It makes little difference which cylinder is mounted in the stack, as the steam pressure is about 180 pounds and its saturated temperature therefore about 380° F., so that for tandem compounds the high is usually put in the stack and for cross compounds both are mounted together in the dome, the temperature being about the same in either stack or dome.

Browsing around a little more with the pruning knife; those little steam feed pumps of our ordinary plant do not appeal to us. They use up so much steam that they take, first and last, one-seventh of all the steam made just to feed the boiler. Suppose we mount a feed pump on the boiler and drive it off the main engine with an eccentric, cutting down this expense to the mere mechanical work done on the pump. For a stand by and to feed the boiler when the engine is not running we will use a small injector.

Now if all these economies are added up, they amount to a saving of 65 per cent of all the steam required in the ordinary wasteful steam plant; and actual tests running on electric light service agree with this, for they show the steam consumption to be less than *nine* pounds of steam per hour per horsepower, whereas it takes 30 pounds for a good engine with us. Therefore a boiler only one-third the size is required, and, since the boiler wastes 20 per cent of its heat up the stack in ordinary plants, this loss also is reduced one-third. Whence it is not surprising to find that the coal consumption of these German units is only *one* pound of coal per horsepower for a 75 horsepower unit, against four pounds for an ordinary 75 horse boiler and engine.

Our illustrations and sections show how these engines are built and what they look like. They are, in effect, a small, compact, semi-portable power plant, no larger than some agricultural steam threshers requiring



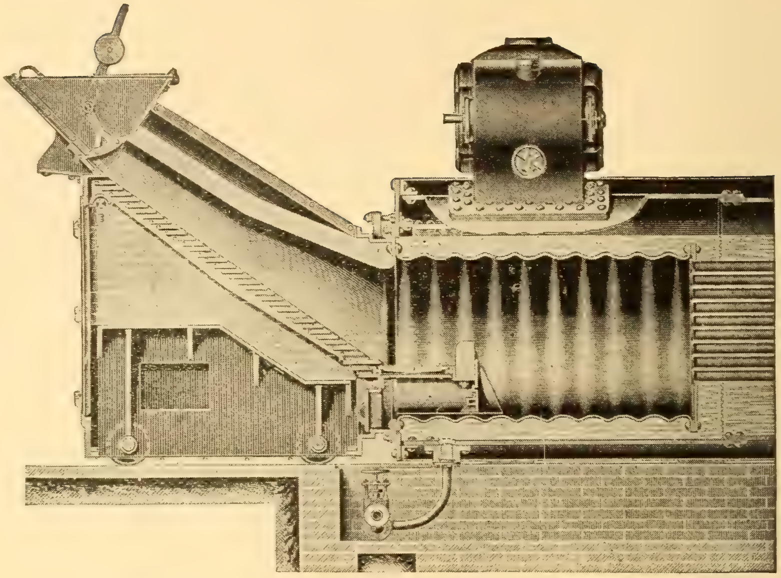
SECTION OF A TANDEM-COMPOUND "LOCOMOBILE"

only a small power house, easily kept clean and in good order.

Is it any wonder that with such a unit, of economy equal to the largest ocean steamer turbines, that over 6,000 such plants, ranging from 40 horsepower up to 1,000, are installed all over Europe? And, moreover, the engine today supplying over one-half the entire light and power for the Brussels World Exposition of 1910 (shown in the December issue) is not a large, lengthy steam-engine, but a 1,000-horse Lanz superheated steam unit, occupying complete with generator a floor space of only 25 by 35 feet.

And now, we come to where this economical steam consumption fits into the scheme of things for the power of the future. You will note that this low steam consumption and small boiler permits the use of all sorts of low-grade fuels by simply arranging special grates for fuels that an ordinary boiler firebox couldn't think of handling. These units have for good coal a grate only one-fourth the size of our ordinary fire box. When they make it larger it is to burn bark or straw or corn husks—something that will not even make good fertilizer. And, as these plants can be set down in the tropical forests of Africa right out of a steamer's hold, ready to run on cocoanut shells or sugar-cane *bagasse*, they have been pushed by enterprising German and French traders to the uttermost parts of the earth.

What will be the next step in advance toward the steam power of the future? Science indicates it as clearly as she pointed to the superheated steam unit to avoid cylinder condensation and general waste losses. Suppose we combine the superheated steam units with a low pressure turbine and catch some of those heat units rejected into the condenser, turning them into useful work?



HOPPER GRATE FOR LOW GRADE FUELS

In a pound of steam at 150 pounds pressure expanded down to ten pounds absolute, or ten inches vacuum, there are 155,000 foot-pounds of work. If we keep on down to one-half pound absolute or 29 inches vacuum, there are 275,000 foot-pounds of work available, or nearly twice as much. But, after the superheated steam engine—or any engine for that matter—has expanded the steam down to about four pounds absolute, or 22 feet vacuum, it is *forced* to reject it into the condenser without getting out any of these 100,000 foot-pounds of work still remaining. Why? Because of the enormous volumes of space that a single pound of steam at these low vacuums occupies. No cylinder big enough to use it can be built. At four pounds absolute a single pound occupies about 90 cubic feet, which is about the limit for the low-pressure cylinder. At 28 inches vacuum the same pound of steam takes 350 cubic feet of space, and at 29 inches it takes 715 cubic feet! We can get the vacuum easy enough, but *we can't use it.*

And right here steps in the low pressure steam turbine. Large volumes of steam do not worry it any. The more you shoot over its blades the better—half a dozen nozzles around the same wheel if need be. From four pounds absolute down to one-half pound is no great drop to expand through, so that it is easy to arrange the blades to convert all the pressure into work, no matter how much volume of steam has to be handled. The combination of reciprocating engines with low pressure turbines has been adopted with signal success in large central power stations, the turbines being inserted between the exhaust of the reciprocating engine and the condenser on purpose to catch these 100,000 foot-pounds of energy.

The combination of the superheated steam unit with the low-pressure turbine has not been tried as yet, except on a laboratory scale, but there is no reason mechanically why such a turbine should not be mounted on the engine and geared to the crankshaft. With such an arrangement nearly doubling the already high economy of the superheated steam unit, we should see a horsepower of work forthcoming upon the evaporation of five pounds of steam on one-half pound of coal; or $1\frac{1}{2}$ pounds of refuse.

As this is more than twice better than the gas engine and producer can do at present it will be some time before the funeral knell is tolled over the steam engine. The logical place for each will be—for the gas engine the large central station, for the steam engine, the moderate-sized isolated plant.

(To be concluded.)

Twenty-five Storage Battery Suggestions

Manufacturers usually furnish explicit directions as to care and operation of their storage batteries and these should be carefully adhered to. The following directions, however, may assist the beginner:

(1) Learn to prepare the electrolyte. Use a large earthen crock or lead vessel with burnt seams. One part of chemically pure concentrated sulphuric acid is mixed with several parts of water, the proportion of water varying with the type of cell, from three parts to eight parts. Specific gravity of a suitable acid 1.76.

(2) Always pour the acid into the water, never the reverse.

(3) Use pure water either distilled or rain water.

(4) Allow the electrolyte to cool before placing in the cells. The specific gravity should be 1.200 or 25° Baume. Add distilled water if a higher reading is obtained.

(5) Grids should always be at least ½ inch below the surface of the solution.

(6) Woolen clothing is little affected by acid.

(7) Ammonia immediately applied to a splash of acid on the clothes neutralizes the acid and prevents a hole being burnt in the material.

(8) In case a bit of acid splashes into the eye wash well with warm water and put into the eye a drop of olive oil.

(9) Avoid the use of an open flame in a room where a storage battery is being charged or in which it has been left for some time, as an explosive mixture of air and hydrogen may be formed.

(10) Prepared electrolyte may be purchased if desired.

(11) Storage batteries are rated in ampere-hours, this being based on the *steady* current the battery will discharge for eight hours. A battery that will discharge at five amperes for eight hours without the voltage falling below 1.75 is rated as a 40-ampere-hour battery. This does not mean that 40 amperes would be the output of the battery if discharged in one hour. The ampere-hour capacity decreases with the increase in current output.

(12) The current in charging should be kept within the maker's specified limit. One authority advises for rapid charging covering a period of three hours, 50 per cent, 33 per cent and 16⅔ per cent of the total current for each consecutive hour.

(13) The e. m. f. of the charging current at starting the charge should be about five per cent higher than the normal e. m. f. of the battery. After a few minutes this voltage may be 10 or 15 per cent of the normal battery e. m. f. However, the battery is kept in the best condition by using a constant charging current and if necessary to maintain this the voltage may be raised to 40 per cent of the normal battery voltage.

(14) Be sure the positive pole of the charging mains is connected to the positive side of the battery.

(15) To determine the polarity hold the two wires in a glass of acidulated water or electrolyte, keeping them at least ½ inch apart. Gas will collect most at the negative lead.

(16) A cell is fully charged: (a) If, with a constant current, the voltage and specific gravity do not change for 25 or 30 minutes. (b) When the plates decidedly increase the quantity of gas given off. (c) When the specific gravity measures 1.2, and the voltage from 2.5 to 2.7. (d) When the negative plate assumes a light gray color and the positive plate turns a dark brown.

(17) Never short circuit the terminals of a cell to determine if it is charged. This may be found out approximately by connecting a two-volt lamp across a single cell and noting its brilliancy. A small dead-beat voltmeter reading from zero to three volts is a convenient instrument and is not expensive.

(18) Lead cells should not be discharged below 1.7 volts.

(19) Boiling does no harm unless the paste is loose, when the agitation will remove it.

(20) If the cells are hot while charging reduce the charging current.

(21) If a battery is not in use give it a short charge once a week.

(22) If white sulphate is formed on the grids it may be reduced by charging at a high rate or overcharging at a low rate for two or three hours.

(23) Continued sulphating will buckle the plates as will also too rapid discharging.

(24) A cell that has been short circuited should be disconnected from the battery and charged and discharged several times separately.

(25) Makers furnish directions for keeping batteries when not in use. One way to do this is to charge the battery fully, then siphon the electrolyte out of the jars, to be kept until again used. Then fill the cells with clear water and discharge the cell at the normal rate until the cell shows less than one volt. The plates may then be removed and stored.

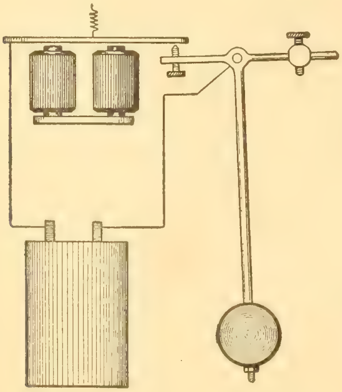
Pocket Testing Lamp

TESTING LAMP

Instead of using pocket voltmeters, many European motorists carry miniature four-volt lamps with short flexible terminals, mounted in boxwood cases. The brightness of the lamp gives a sufficient indication of the condition of a battery cell to make it serve as a cheap and compact substitute for a voltmeter.

An Electric Pendulum Clock

Those who have wondered how electrical clocks were driven and how complicated an arrangement of magnets and springs they require will be interested in the accompanying sketch showing the mechanism of an electric pendulum clock designed by Prof. M. C. Fery of the School of Physics and Chemistry of the city of Paris. Prof. Fery has equipped a simple pendulum with a crossbar having a screw tip which just touches the tip of a magnet armature at one end of the pendulum's swing, thereby closing a battery circuit through the magnet. This immediately draws the armature to it, giving the pendulum a fresh start and breaking the circuit which is only closed for a very short time. Thus at each swing of the pendulum the battery gives it enough of a push to overcome the friction of the gears driven by it and the result is a simple timepiece having no springs except the little one that raises the armature after each impulse.



ELECTRIC PENDULUM CLOCK

Making New Solvents

Some of the intensely interesting work which has been done during recent years by electrochemists is reflected by certain of the foreign patent applications of Mr. Clancy covering new methods of treating ores which contain precious metals. They are based on the remarkable discovery that certain chemical solutions which will not dissolve ores under ordinary conditions, will do so readily if a current of electricity is passed through them. Consequently the reducing and refining of ores can be done by means of chemicals which heretofore were believed to have no effect upon the same ores and a similar situation will undoubtedly apply to other chemical processes. For instance, Mr. Clancy proposes to utilize some of the cheap fertilizers which are now produced in France by electrical means, using an electric current to liberate oxygen in the liquid and thereby change its possibilities. If this line of research is extended we may have to revise our present lists of the solubilities of chemicals in liquids, as many heretofore considered insoluble may prove to be easily dissolvable in the presence of an electric current.

Cleaning an Edison Primary Cell

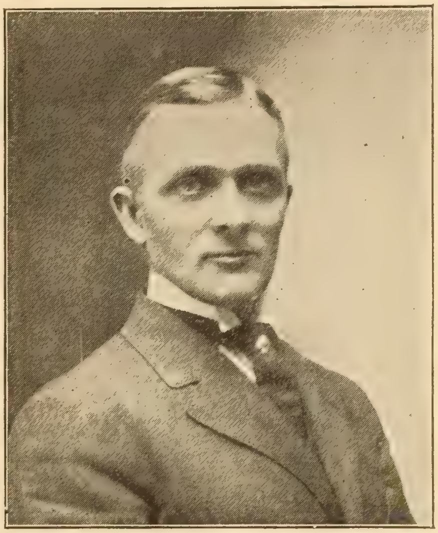
As many have trouble in cleaning the Edison or Gladstone primary cell before recharging I submit the following directions, which I have found work well: Remove the cover, stir the solution well and empty out quickly, thus leaving no sediment in the jar. Wipe the jar out with a piece of cotton waste. If oil adheres to the jar use a little muriatic acid on the waste, then wipe finally with clean waste. Clean the copper plate also with acid and wipe with a dry cloth. Handle the acid with care and use as little as will do the work.

R. S. KRAUSE.

Electrical Men of the Times

C. H. THORDARSON

We are accustomed to associate with men of the Northland a certain steadfastness of purpose and seriousness of mind engendered by constant strife with unfavorable elements. Although C. H. Thordarson is an American in every sense of the word, having come to the United States at the age of six, he is by birth an Icelander and his parents lived in Iceland until they exchanged the rigors of the Arctic Circle for the wild woods of Northern Wisconsin, which was in 1873. Such were the environments in which young Thordarson lived until he came to Chicago in 1885 to take up the study of physical science, which had for him an intense fascination.



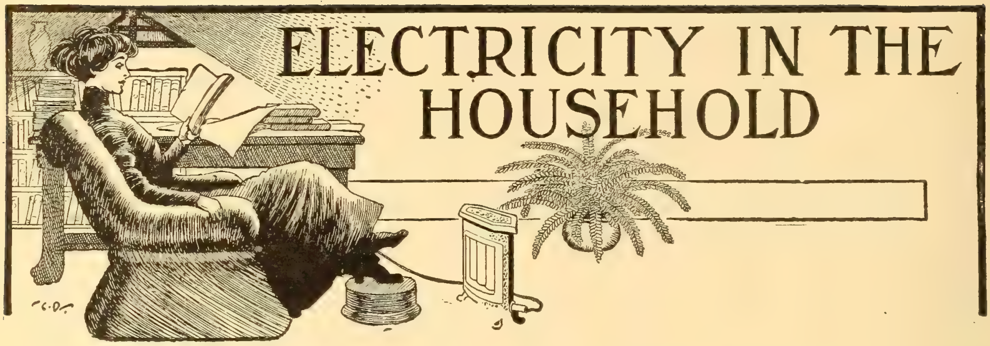
In those days Professor H. V. Richards conducted a supply house devoted to physical science apparatus of all kinds and here Thordarson received his first real scientific training under the guidance of Professor Richards, and incidentally learned the commercial side of the business. During the next ten years he became associated with various manufacturing enterprises and also with the Chicago Edison Company, which was the last firm for which he worked before going into business for himself in 1895.

When this young man started out for himself he had two things on which to build—a capital of just $75, and an unbounded determination eventually to have the most fully equipped electrical high tension laboratory in Chicago. He has made that $75 go a long way, and slowly and persistently he has evolved from it a business in which 100 people are now employed in a shop and laboratory which in many respects is unequaled anywhere. Not a cent of outside capital has ever been put into the business, which nowadays is an unusual thing.

Almost every university and technical school in the country bears evidence in its physical and electrical laboratories of the work of Thordarson. Therein you will find transformers, high frequency apparatus, electric welding and heating appliances, and experimental equipment of a multitude of kinds—special types every one, which are individually the products of his inventive genius.

Some years ago, when the International Electrical Congress was in session at the St. Louis Exposition, they wanted a great transformer of 150 horsepower which would deliver current at the enormous pressure of a million volts. They sent a hurry call to Thordarson. In 28 days that transformer was standing in a little building on the Fair grounds—the largest apparatus of its kind which had or has ever been built. So much for size, yet Thordarson has gone to work just as enthusiastically and designed a little transformer to ring a door bell.

In disposition, Mr. Thordarson is of the retiring kind, and, like most deep thinkers, so absorbed in mind as to be considered by casual acquaintances as always serious. As acquaintance reaches a closer friendship, however, it is found that the somewhat dreamy eyes of the inventor can twinkle with amusement, and his quick, nervous way of appearing to wish to hurry back to his enthralling experiments gives place to hearty geniality—but, then, you must know him pretty well before he will fool away much time with you. Just now he is engrossed in the plans for a greater and more complete laboratory, although he can gather from them no more pleasure than when he was planning on spending that first $75.



ELECTRICITY IN THE HOUSEHOLD

Where Art and Science Meet

By T. VERNETTE MORSE

The present almost universal desire to return to the simple life seems to me to be the result of a better understanding of the fitness of things and a healthy release from the bondage of conventionality.

The writer, at one time a landscape painter of some repute, has devoted a life time of study to this phase of art expression. The painting that is a mere copy should never be allowed space in an exhibition. It is only when the painter interprets intelligently Nature's handiwork, translating her message as it is revealed to him that his work rises above the mediocre. The art that puts into action the best forces of mankind, the art which is so strong and broad that it contains the formative principles of true character is the only significant art.

The real laboratory for the promotion of such an art is the home—not the home of great paintings, but the home of love and joy. The home where spontaneous invention bursts forth like a joyous peal of laughter, a home where pictures and other esthetic things are appreciated for the message they bring and not for their technique.

To the woman of good taste and artistic training the home offers a field more far-reaching in its influence than either studio or great exhibition, for the home has to deal intimately with that greatest of all things—life—from which all else must be developed.

To live the life the Greeks lived is quite impossible in this modern electrical age, but it is possible to achieve in the home life of today as great and lasting a cultivation of the artistic side of life as it was 3000 years ago. The principal evil to be combatted in these times is the tendency to become buried in the details which are an accompaniment of our complex mode of living and which cause us to lose sight of the higher things which make life more enjoyable. In the home this tendency is perhaps more marked than elsewhere, and too often it is found that the housewife is a slave to the burdens of caring for or superintending the operation of the establishment. To make possible the conservation of her energies to the end that she may enjoy life to a fuller extent is a great problem.

Continuous study and application of these theories gave to the writer early in life, a desire to keep constantly in harmony with Nature's great and inspiring lessons, and art study was the avenue selected.

There was at that time no American art except that little group now referred to as the Hudson River School, but there was always an opportunity to awaken local interest, through the organization of art clubs, which were as a rule, more social than artistic, however they served as a nucleus for better things. I recal one where nearly everyone of the younger members have made a reputation in the art world and several that afterwards developed into strong healthy art schools.

The Columbian Exposition suggested a still broader field of endeavor, opening the way for the publication of the first Chicago art magazine to acquire both a national and international reputation.

With no assistance whatever, having no knowledge of the publishing business but with absolute confidence in my subject, I launched the *Arts for America*, and stood at the helm for nearly ten years. The constantly increasing circulation bringing with it the usual cares and responsibilities.

This experience taught me that an art magazine was merely another means of promoting theories, and the desire to stop preaching and enter the field of real activity became greater each year.

In the meantime the Paris Exposition of 1900 had awarded to *Arts for America* a medal and diploma for excellence which was most gratifying—as I looked at this medal and compared it with a former one that had come to me as a landscape painter, the temptation to adopt one of the professions as a life work was uppermost, but they had failed to satisfy me in the past and I had no reason to believe that the future would be different. Whatever honor or glory the medals carried with them was put aside for the purpose of entering a new and, at that time, untried field.

As a means to the end the Artcraft Institute was established in Chicago, December, 1900, incorporated without capital and not for profit, but for the sole purpose of uniting the best elements of the home, school, club and workshop on a common ground so broad in its scope that the principles of art should be recognized as the legitimate property of the individual, who, by virtue of that ownership should be encouraged to adopt the occupation through which he could best express himself, no matter how commonplace it might seem to others.

This somewhat unique plan was a success from the first and has been approved by the leading educators and manufacturers of the country. All instruction is individual—all unnecessary side lines are eliminated. Diplomas are awarded for the work accomplished and not for the time consumed.

The graduates occupy responsible positions of trust because of the knowledge that comes from practical experience.

Another feature of the Artcraft Institute is the philanthropic department under the auspices of the Guild and patrons, who give time and money for the purpose of assisting women of culture and refinement who are unexpectedly thrown upon their own resources, how to select and develop some occupation whereby they may support themselves and families. Women as a rule do not need more "all round" education, but they do need a working knowledge of at least one craft.

Every department of woman's work is practically covered. Drawing, designing and modeling is taught for the purpose of applying the principles to the work in hand.

In the domestic department all demonstrations are conducted on the most modern scientific principles, a regular home laboratory where up-to-date labor saving devices take the place of old time drudgery. Under the new regimé housekeeping may be a joy to the young matron who does not care for the services of a maid.

Throughout the entire year practical demonstrations of recent labor saving devices are given by inventors and manufacturers. Materials and foods are tested. A complete record of all approved goods is placed on file for references.

This unique educational combination is not the result of a definite plan, but has been a natural growth arising from present day conditions. It encourages the freedom of personal expression. It admits of the use of the machine as well as the hand.

In the work thus undertaken electricity has been recognized as one of the most successful modern agents in the simplifying of household tasks, and it is my intention in succeeding chapters to explain to the readers of this department, in a perfectly simple and non-technical way, how they may employ this unseen force; how, by its use that occupation which we have been pleased to term "housekeeping" may be made an incidental rather than an all-absorbing task, leaving part, at least, of a woman's time to be occupied in the cultivation of those things which make for a higher intellectual and artistic development. In these talks I will attempt to explain not only where art and science meet but how they overlap and by united forces add to the joy of living.

Woman's Influence in the Automobile Field

While the electric automobile can hardly be classed as a household article, still it is an accessory to so many homes that it may very well be given some attention in this department. That buyers this year are paying more attention than ever before to those features which add to comfort and convenience and less to speed may be attributed largely to woman's influence.

It is doubtful if the average woman *ever* cared for as much speed in a motor car as a man. Her delicate nature does not take kindly to being bumped over rough roads at the speed of an express train and her love of the beautiful demands a pace that will permit an intelligent appreciation of the scenery along the way. Her influence is seen, too, in the exterior finishing of the car—flaming reds, feverish yellows, etc., having given place to more subdued and artistic color tones.

But while woman's influence has undoubtedly done much to subdue the speed mania, it would be wrong to give her all the credit. There has been even more potent force working to bring about this change—the psychological fact that when a man gets what he wants, he no longer wants it.

Before the advent of the motor car, man was forced to travel the road at a speed not to exceed fifteen miles an hour. The motor car offered a way to obtain 60. Man took advantage of it, demanded it for a while, then found that he didn't want it—didn't need it.

For comfortable traveling, 30 miles an hour is enough. The real value of a motor car to the average individual is not that it can make 70 to 80 miles an hour on a track, but that it can make 20 to 30 miles an hour on a road, and be ready to repeat the performance day after day.

The motoring public has come to realize this and so the speed era has been succeeded by an era of comfortable motoring.

As an illustration of this one need only cite the largely increased use of the electric vehicle. The handsome appearance, the case of operation, cleanliness, noiselessness of the electric makes a strong appeal to women. It requires little if any attention on the part of the operator and can be driven without danger of soiling the daintiest toilette.

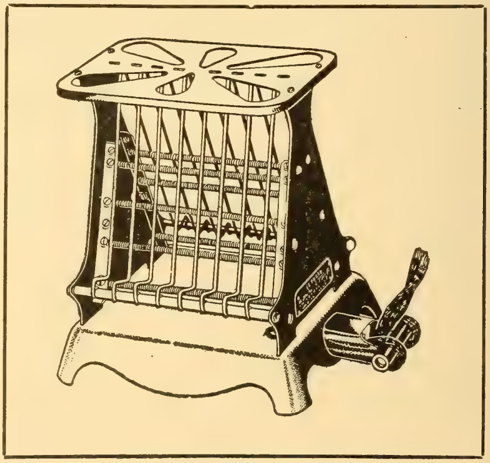
Of course the increased mileage capacity of the electric has something to do with the largely increased use. Eight years ago 40 miles on a single battery charge was about the limit for any electric. Today it is not unusual to hear of electric vehicle owners driving 70 to 100 miles without stopping for a charge and electric cars have been driven over 200 miles on one charging of the battery.

This big increase in mileage capacity is largely due to the perfection of batteries, among them the new Edison battery, and to the fact that a more thorough knowledge of the battery has enabled electric vehicle manufacturers to build motors which work in better harmony with it.

As an illustration of what has been accomplished along this line a recent run made by the Detroit Electric—the first electric to adopt the Edison battery—is of interest. This run, which was made in Detroit on October 5th, resulted in the remarkable record of 211.3 miles on a single battery charge.

Improved Toaster

"Improved" seems to be the watchword as to household electrical devices. The Pacific El Tosto here illustrated shows something new —a warming table on the top to keep the coffee pot or any other dish warm during the meal. If you wish to prepare zwieback just lay the toast upon this shelf until it is well dried through.



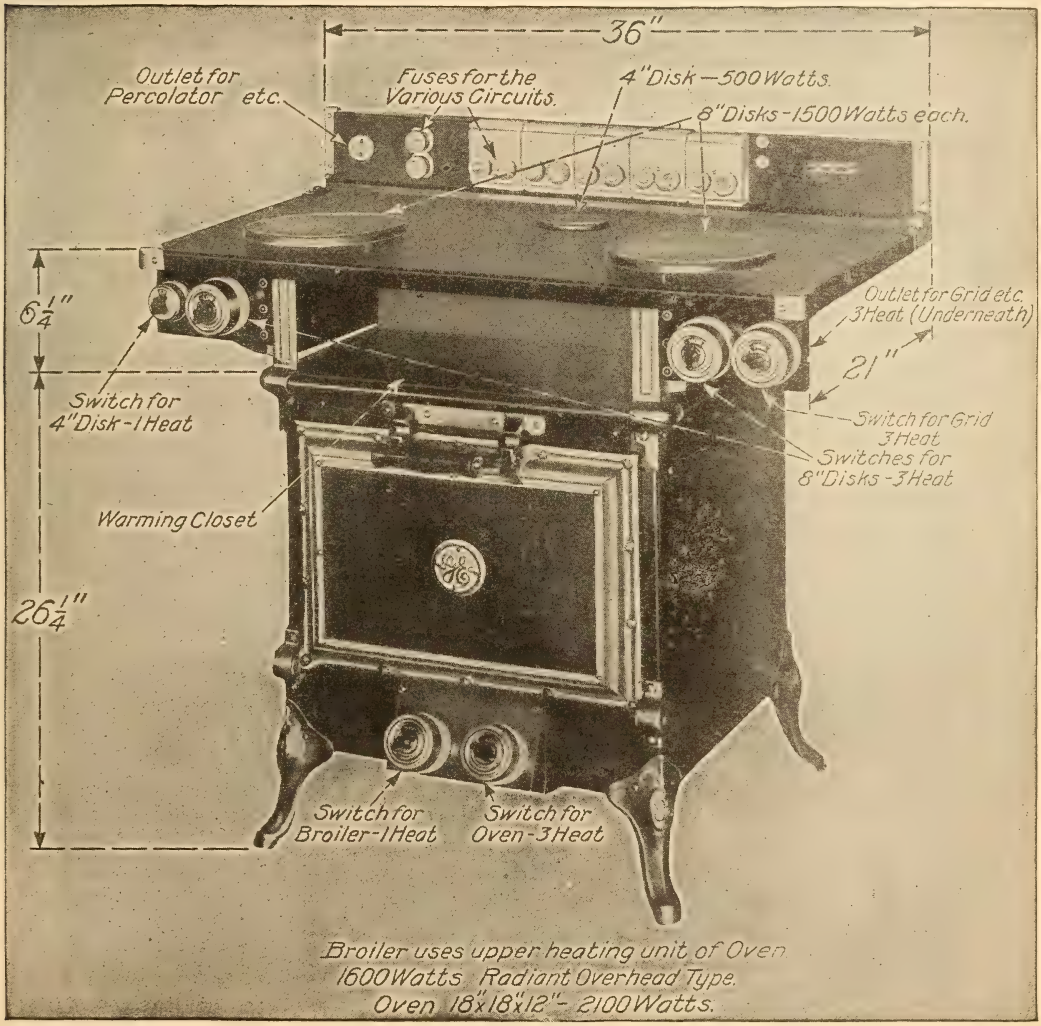
AN IMPROVED TOASTER

A New Electric Range

The domestic electric range recently perfected by the General Electric Company is a decided advance in the right direction. The stove as illustrated is similar in pattern to the ordinary gas range. The three disks on the top of the range are used like the burners of a gas range.

A turn of the snap switch turns on the heat instantly at full intensity, while another turn cuts it off and so avoids any expense for current when the stove is not actually in use, without incurring a delay in getting it into operation again. The two larger disks are provided with a switch which admits of a three-heat regulation, thus making it possible to get a low, moderate or high heat as conditions may require. The three disks permit cooking one, two or three things at a time.

The combination oven and broiler is commodious, being 18 by 18 by 12 inches, ample for the needs of a large family and is provided with heating units at both top and bottom. By removing the ceiling plate of the oven, the top heating element of the latter is exposed and may be used as an overhead radiant broiler for the purpose of adding a pronounced brown to pies, biscuits, roasts, and the Thanksgiving and the Christmas turkey. The broiling pan (which is furnished with the range) is also suitable for use as a roasting pan. Printed instruc-


36"
Outlet for Percolator etc.
Fuses for the Various Circuits.
4" Disk—500 Watts.
8" Disks-1500 Watts each.
6¼"
Outlet for Grid etc. 3 Heat (Underneath)
21"
Switch for 4" Disk-1 Heat
Switch for Grid 3 Heat
Switches for 8" Disks-3 Heat
Warming Closet
26¼"
Switch for Broiler-1 Heat
Switch for Oven-3 Heat

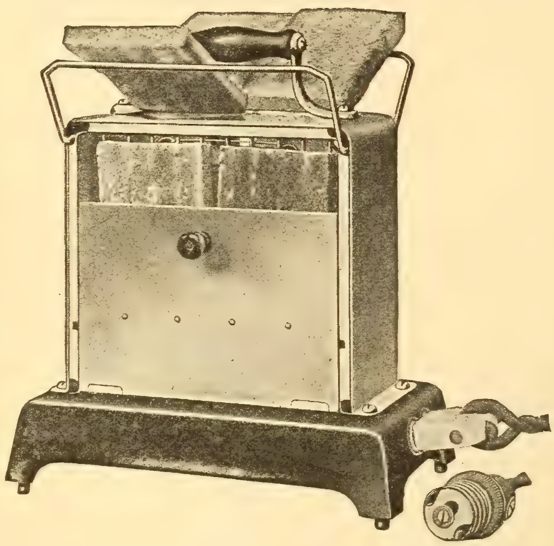
Broiler uses upper heating unit of Oven
1600 Watts Radiant Overhead Type.
Oven 18"x18"x12"- 2100 Watts.

NEW ELECTRIC RANGE

tions accompany each range, and tell what "heat" to use and how long to leave it on to bake or roast the various kinds of meat, bread, cake, pie, etc. The stoves, broiler, and oven all have independent controlling switches.

Not forgetting that the modern housewife knows that a breakfast of nicely browned griddle cakes accompanied by a cup of such coffee as can be made only on an electric percolator will start *him* off to his work in the proper frame of mind, a connection for a coffee percolator and one for a grid on which to make the cakes are provided.

A New "Wrinkle" in Toasters

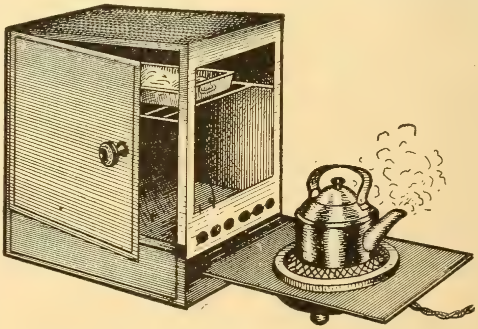


A NEW "WRINKLE" IN TOASTERS

The improved Simplex electric toaster embodies two wire supports projecting upward at an angle of 45 degrees from either side, coming out of the top of the toaster. This provides a supporting bar to rest one end of the slice upon. The other end rests on the frame. This in no way interferes with the operation of the device but provides a way of drying fresh bread while other toast is in the making or keeping warm toast which is already made. When toasting is finished the supports drop out of sight inside the frame. Like a good servant, the toast rack is never in evidence except at the time when its services are desired.

Combination Oven and Warming Plate

In using gas, it is usually difficult to obtain the heat other than in an upward direction, even though this may not always be the most desirable for the purpose at hand. Most of the gas stoves used in kitchens show this limitation and the makers of electric heating devices have been delighted at being unhampered by this objectionable feature. With electric ovens or stoves the heating element can be placed in any position or location that may seem best suited for the cooking to be done by it and it may even be movable. An interesting illustration of this is found in a new electric oven offered by a Scotch firm which has the heating element fastened to one side of the oven. When the oven is not needed, this whole side of the oven can be swung outward to form a heating plate for use with teakettle, coffee pots, or the like. Such a change would be manifestly impossible with any gas heated device, yet it is but one of the wide range of new combinations which electricity is bringing to our kitchens.



OVEN DOOR USED AS WARMING PLATE

JUNIOR SECTION

Construction of Small Motors and Dynamos

By CHAS. F. FRAASA, JR.

CHAPTER I.—BUILDING THE BORING MACHINE AND DRILL-PRESS

In every amateur's electrical laboratory there is always need of two or three small dynamos and motors, for experimental and other purposes. Many amateurs purchase these from dealers, getting good machines, while many others find it profitable and instructive to construct their own apparatus. While effecting a considerable saving by doing this the amateur also receives the benefit of the construction, since he makes each part and is thus in a position to understand the principle of operation of the whole machine after it is assembled.

To build good serviceable dynamos and motors, ordinarily requires the use of a number of shop machines to which the amateur generally does not have access. It is for the benefit of such amateurs that these articles will tell how to construct cheaply without the use of a lathe or other regular machine-shop machine, good, efficient and serviceable dynamos and motors. Along with the usual complement of tools, it is assumed that the amateur has a pair of heavy shears, or tin-shears, and a stock and dies that will work on bolts and nuts up to about one inch in diameter. The stock and dies are not necessary, but better work can be done if they are available.

BORING MACHINE

For doing the machine work on these models the apparatus shown in Figs. 1 to 6, should be built. This machine is to serve as a drill press, a boring machine or a lathe. It can be constructed at very little expense, and will be found of much service in building a dynamo or motor, and later makes a handy lathe or drill-press for other work.

The machine, Fig. 1, consists essentially

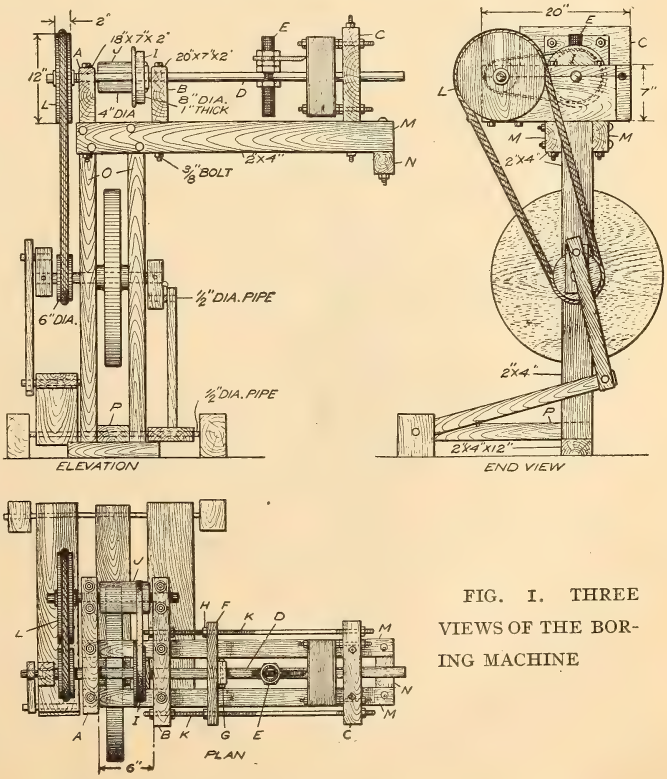
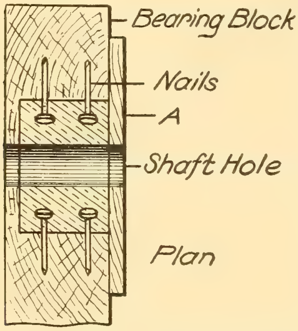


FIG. 1. THREE VIEWS OF THE BORING MACHINE

of a shaft (D) which carries with it upon revolving, the tool-holder (E) containing the tool; the combination of a key (G), strip (F) and nuts (H) on the bolts or threaded rods (K) which feed the tool for cutting, also a tight narrow pulley (I), and the wide pulley (J) which is fastened to a shaft driven by a belt from the pulley of the foot power to the pulley (L).

The operation of the machine is as follows: the power from the foot-power fly-wheel, which may be of metal or heavy hard wood, is transmitted to the grooved pulley (L) either by leather or rope belt. From the pulley the power is transmitted through the shaft to the wide pulley (J); by belt it is then transmitted to the narrow pulley (I). Since this narrow pulley (I) is fastened to the shaft, the shaft carrying the tool revolves, turning the tool with it. If the nuts (H) are now screwed up, the strip (F) will move forward and the tool will cut any material that may be on the board (C).



FIG, 2. DETAIL OF BEARING

The first operation in constructing the machine for any size of model other than the one here dimensioned, is to determine the proper size of all its parts. In general the blocks (A), (B), and (C) should be at least two inches thick, and if possible, should have similar dimensions otherwise, but (A) and (B) may be made only of sufficient height to hold the bearings, and long enough to support the pulley (J). If they are of the same size, it will be easier to line up the blocks and the bearings. The distance between the blocks (B) and (C) should be equal to the length of the bore to be made, plus the length of the dynamo shaft, and that between (A) and (B) should be about one inch more than the length of the bore plus the width of the pulley (I). The pulleys should be of such diameters that with the greatest diameter of bore, the cutting speed in feet per minute shall not exceed fifteen feet. The pulley (J) should be as long as the length of the bore plus about two times the width of the pulley (I).

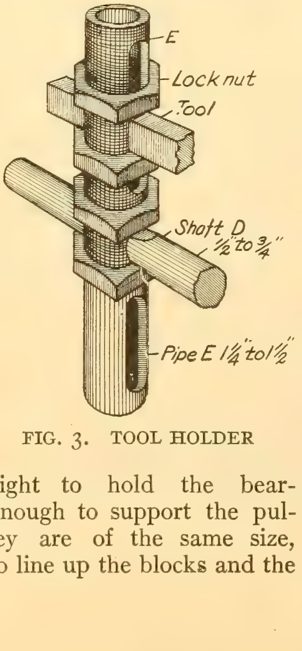


FIG. 3. TOOL HOLDER

The shaft (D) and the shaft of the pulley (J) should be at least ½ inch in diameter, but (D) should preferably be ¾ inch in diameter. The length of the shaft (J) may easily be calculated from Fig. 1, and the shaft (D) should be equal in length to the distance between the external faces of the blocks (A) and (C) plus, say, one inch more than the bore or feed. The bolts (K) should be about ⅜ inch in diameter and of ample length, as shown. The blocks should be bolted down with ⅜ inch bolts. The base should be large enough to support the whole, and strong enough to hold it firmly, say of two-by-fours as in the diagram. If the amateur already has a foot-power, or a motor, he may belt it to the machine

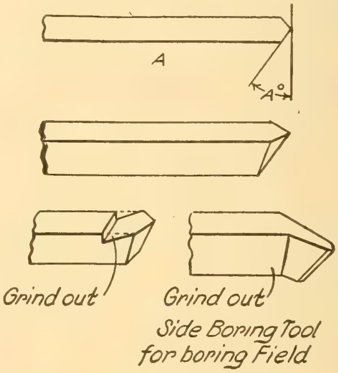


FIG. 4. CUTTING TOOLS

CONSTRUCTION OF A BORING MACHINE FOR BUILDING A FIFTY-WATT GENERATOR OR MOTOR

For the base and the foot-power support two pieces, one 2 by 4 by 36 inches and the other 2 by 4 by 42 inches will be required. Spike the parts together, or bolt, as shown in Fig. 1. The piece (N) should be about eight or ten inches long. This piece serves to hold the two parts (M) four inches apart on the one end, while the two legs (O) hold them at this distance at the other. When the machine is completed, the end may be supported and given additional strength by fastening it to the wall of the shop. The legs (O) should be about three or four inches apart at the top and bottom, and should have as a bottom piece a 2 by 4 by 12 inch piece spiked to them. Between the two legs, fasten a 2 by 4 by 20 inch piece to bear the treadles.

Now cut the bearing blocks (A), (B) and (C). Drill the holes for the ⅜-inch bolts which fasten the blocks to the base, and also drill for the bolts (K). Then after taking careful measurements drill the bearing holes so that they will be in line when placed in position. To make the bearing holes, drill to within one-fourth inch of cutting through with a drill of more than one inch greater diameter than the shaft. Then complete the hole with a drill of the same diameter as the shaft. The resulting projection will hold the bearing in line while pouring in a babbit, and will give a tight fit which will prevent the metal from running out. To cover the other end of the bearing hole, cut from a board of ¼-inch wood, a piece (A), Fig. 2, about one or two inches larger than the bearing hole and drill a hole in the centre of it the same size as the shaft.

Drill a ½-inch hole from the top of the bearing down to the shaft hole, and then with a wood saw, cut the bearing in two horizontally through the center of the shaft hole, and drive a number of nails into the wood in the larger hole to secure the babbit in place. The top of the bearing should now be put in place, and the bolts slipped through the holes in both parts. Raise the top and on each side of the shaft, insert a piece of thin cardboard, which has a saw-toothed edge, the serrated edge touching the shaft. This edge should have very coarse teeth, so that the babbit from the top will run to the bottom when pouring. Put the block of ¼-inch wood on the opposite end of the shaft, (A), Fig. 2, The shaft should now be chalked or smoked to prevent sticking, and put through the bearing hole. The bearing should then be bolted down tight, the block (A) held tight against the bearing block, and the molten metal poured through the one-half inch hole in top. When it has cooled the shaft may be driven out and the bearing split along the toothed edge by driving a tapered pin in the hole. A ¼-inch hole may now be drilled in the top part of the bearing through the one-half inch column of metal, for an oil hole. This should not come quite into the shaft hole. Now drill a small hole through the thin metal remaining sufficient to allow the oil to pass to the bearing.

For the shaft of this machine which will later be used as the shaft of the model, cold rolled steel shafting which you can obtain at a machine shop may be used though blacksmith's rolled soft steel rods which are much cheaper will do just as well. The shaft should be one inch in diameter and four inches longer than the distance between the external faces of the bearing blocks (A) and (C).

For the tool-holder (E), shown separately in Fig. 3, will be required a piece of pipe slightly larger in diameter than the shaft, 1¼ to 1½ inches in diameter internally and just short enough to clear the rods (K) when revolved at its centre upon (D) as an axis. When purchasing this from the plumber, have him cut threads on it from end to end. Provide also four lock-nuts, or make them yourself of strip-iron or blank nuts threaded by the plumber. With a file and a hack-saw cut holes on opposite sides at the middle of the pipe for the shaft (D) to pass through. Cut slots also on opposite sides of the pipe to hold the tool at the proper distance for boring. These slots should be rather long so that the tool may be arranged for turning different diameters. Now file on opposite sides of the shaft, at the position the tool-holder is to occupy, slots equal in size to the lock-nuts, and about ¼ inch deep. Then slip the pipe on the shaft, and turn one lock-nut on each side tight to the shaft so that the pipe is held securely. The two other nuts should now be placed on the end of the pipe which is ready to receive the tool.

For the cutting tools, grind down small files to the shapes shown in Fig. 4. These should be ground cold without taking out the temper of the file, but if the amateur desires, they may be worked hot, tempered to a light yellow color and ground to a cutting edge. The tool may be clamped in the slot in the pipe (E) between two lock-nuts on one end by tightening the nuts. The tool may be fed for different diameters by moving the nuts.

The strip (F), Fig. 1, should be about ½ inch thick and should have a hole drilled in the centre greater in diameter than the shaft, or if of the same diameter should be reamed out. At both ends of it should be drilled holes for the bolts (K) on which it should slide freely. The rods or bolts (K) should now be threaded on both ends, being sure that the thread is long enough to give the proper feed for the tool. The bolts (K) besides acting as a feeding device also serve as braces for the block (C).

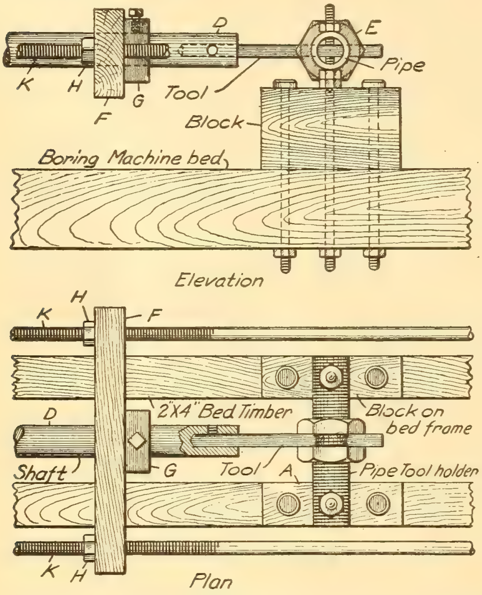


FIG. 5. ARRANGEMENT OF MACHINE FOR DRILL PRESS

The pulleys should be cut out with a small saw or jigsaw, and if not true enough, may be turned true by fastening one to a shaft as a driving pulley, while the other is turned on the same shaft using a chisel on a block temporarily rigged before the pulley as a rest. The pulleys should be fastened to the shaft by screwing or bolting to a strip of iron fastened to the shaft in the same way as the strip (G). This is shown in Fig. 1, on pulley (I). The construction of the remaining minor details is left to the reader.

The belts may be made either of leather or rope. For the leather, grooved or smooth pulleys may be used, but for the rope, they should be grooved. Pulley (J) should in all cases be smooth.

Some changes are necessary to convert this machine into a drill-press. In Figs. 5 and 6, these changes are shown. For this purpose provide a shaft and fasten the piece (G) on it in the same way as on the other shaft after slipping the shaft through the bearings, the strap (F) and securing the pulley (I), Fig. 1. The shaft may now be revolved by the pulley, and fed by the nuts (H). Bolt temporary blocks (A) Fig. 5, in position on the bed timber, remove the tool-holder from the other shaft, and drill a hole in each end and bolt these ends to the blocks (AA). A nut each side of the pipe, on the bolt which holds it, is shown in Fig. 5. These nuts serve also to raise or lower the pipe for centering the tool. The drill (A) Fig. 4, made by grinding a file to the shape shown should be bolted in place in the holder Fig. 5, between the lock-nuts, and the work fed up and bored. The hole should be bored to a depth of from $\frac{1}{2}$ to $\frac{3}{4}$ inch. This is for the drill tool. A hole (T) should be drilled and tapped for the tightening screw (T) Fig. 6. When this is done the drill may be put in the hole and tightened with the screw for drilling. The drills may be made from various sized files, ground to shape, or by cutting off the end of regular drills so that their shanks will go into the hole. This completes the boring-machine.

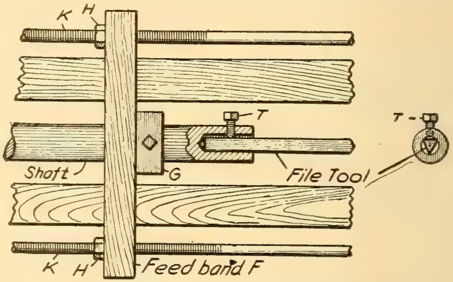
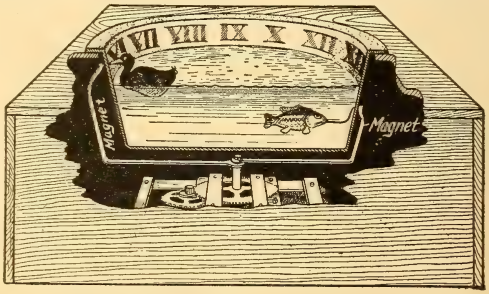


FIG. 6. METHOD OF MOUNTING DRILL

(To be continued.)

A Clock with Swimming Pointers

Sailors have always been proverbially fond of whittling and many are the curiosities built by seamen with a jack knife and some glue as their only tools. But occasionally


VII VIII IX X XI XII
Magnet
Magnet

CLOCK WITH SWIMMING POINTERS

the modern seadog goes further and extends his tinkering even into the electrical lines. Thus a British mariner, Capt. A. Norgate, has built a clock which is unique in that the pointers are moved by unseen forces, being apparently free to float in a large bowl of water around which the figures are marked. Instead of the usual pivoted hands he employs a couple of hollow metal animals, one being a duck which floats on the surface of the water and indicates the minutes with its bill; the other is a fish, weighted so as to stay below the level of the water and hence pass freely under the duck. This fish has in its mouth a brass wire bent upward so as to indicate the hour on the same set of figures to which the duck points. The bowl is set into the top of a neat wooden box and on shaking the same the animals float freely about but soon return, as if by magic, to the points at which they tell the correct time.

The secret of this ingenious clock is easily understood from our cut showing the two light magnets attached to the hour and minute hand of a clock contained in the box. The duck and fish each have a soft iron stem in the mouth so as to be attracted by these magnets, thus moving with them as the time passes. Of course the outside of the globe is painted or covered with an opaque cloth so that the clockwork cannot be seen through it. While built by Capt. Norgate merely as an interesting curio with which he might puzzle his acquaintances, such a clock if placed in a show window would probably make a novel window attraction.

Electrical Stunts

By "SPARKS"

Not so very long ago in POPULAR ELECTRICITY there was an article entitled "Induction Coils in Vaudeville." I also have been enticed by the rather blatant ads of this greatest of the greatly great electrical wizards, this man who tamed electricity, and I also don't doubt that he wore bracelets connected by cords over his shoulders, used prepared paper to ignite from all parts of his anatomy except his sacred moustache, and other such fakery. Maybe the writer of that article was a bit hard on the "Prof." but he ought to stand it almost as well as the "millions" of volts from his six or eight inch induction coil.

I wish to say that "it can be done" and even then by almost anyone. Even to lighting unprepared paper from the fingers. It takes more than one quick spark though.

A year or so before this so-called professor came to the footlights on the American stage, Weary and I were fooling with a new one-inch induction coil of mine and doing some of the tamer stunts with it such as watching the effect of different things in or near the gap, the electric ladder, lighting Geisler tubes, piercing cardboard and paper and so on.

Then I accidentally noticed that if I touched either one of the secondary terminals while the coil was going I got a lot of short thin sparks on my hand that stung slightly, but didn't shock at all, and that if I took tight hold of the binding post, it only tickled. Weary tried it and didn't mind it any more than I had. Those little sparks surely did sting though on the quick under the finger nails and on our ears, nose, neck and other sensitive places. The worst was a spot right near the pulse of either arm that nearly doubled us up into a knot. We tried it on our tongues and it didn't hurt a bit.

We noticed that if one of us had hold of a terminal and the other touched him, we could get just as good a spark between us as between the one next to the coil and the coil terminal. Also in the gap between terminals, we noticed the smaller the points, the longer the sparks.

Then we tried grounding one terminal of the secondary and we couldn't get any spark to us from that, but when Weary touched the other, he got a much longer and fatter spark than before, but it shocked him so that he nearly sat himself on the floor. I tried to take them and did likewise. By trying persistently and making a good handle out of a bicycle pump and some wire, we could easily hold on and give shocks with the same unconcerned manner that the "Prof." later used on the stage.

I took the sparks on my tongue with no worse effects than a feeling like the pricking of a pin from its tip way to the back. Weary tried it, but the spark jumped to a sore tooth and that set him to doing an Indian war dance around the room, howling like the wild man from Borneo (Greene County, state of Virginia). He said that he might have had a tooth hurt worse, but he couldn't remember when. He let a "painless" dentist extract a molar once and take it from me, that's going some. Then he took it out on me for ha-ha-ing at him when he was hopping around.

One time when I had hold of the handle and the coil was going good and strong, Weary sneaked up behind me and gently placed his pedal appendage against the bosom of my pants and I then attempted to imitate bossy on her justly famous jump over the moon, while Weary joined the little dog in a hearty laugh.

Nowadays we always look twice to see how conditions are before we touch a secondary wire or go near the coil together.

Weary and I found that crepe paper such as that used in making paper napkins was the quickest lighter of any we tried. The way we would light it was to wrap some loosely around our first fingers and hold them as near to the terminal of the coil as possible, but still leaving a gap. Sometimes it would take as long as half a minute before the paper would light. And holding it in the same place for half a minute with sparks streaming into you through that paper is no cinch, but it is worse with an irregular vibrator.

Later we got up a young exhibition for a party that a friend of ours had. We showed them a lot of the simpler stunts and then had our spark eating contest. Of course, we got a couple of the audience up by our apparatus and used them as goats. It worked fine. We had all our coils and gaps fitted up with brass knobs taken from an old bed. It is surprising how the apparent size of a coil is increased by a few knobs and other brasswork. We borrowed a three-inch coil for the evening and let it spark between two sharp points so it would do its longest. The way we fitted it out, it looked like a six-inch coil. The program and paraphernalia are given below:

PARAPHERNALIA

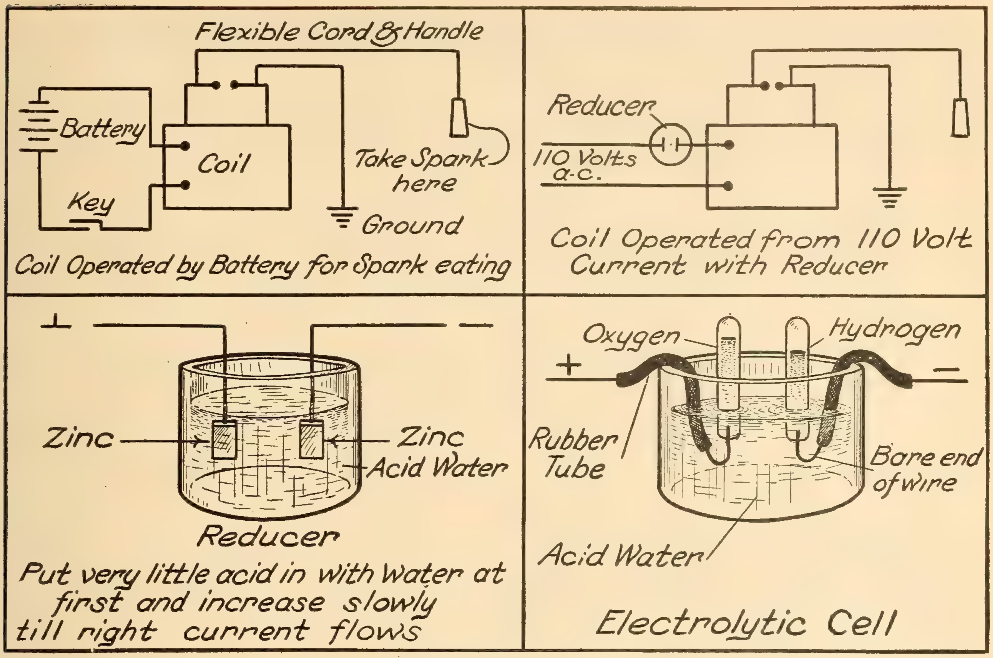
1 Spark coil (one inch or larger, the larger the better).
1 set batteries.
1 single-pole, double-throw switch.
1 piece glass.
1 candle.
Matches.
Paper, crepe paper and cardboard.
1 handle and long flexible cord.
Wire and pliers.
Acid.
1 electrolysis outfit (home made).
1 old lamp bulb.
1 Geissler tube (more if possible).
1 condenser plate (home made).
Iron filings.
Powdered carbon.

PROGRAM

1. Sparks, fireball, brush discharge.
2. Sparks around glass.
3. Spark into candle flame.
4. Piercing paper, card board, etc.
5. Lighting paper and matches in the gap.
6. Powdered carbon, iron filings, etc., in the gap.
7. Electric ladder.
8. Decompose water, burn match in oxygen and explode hydrogen (just light a match by it).
9. Taking sparks from either secondary terminal.
10. Taking sparks from secondary terminal with the other grounded.
11. Wireless.
12. "Spark eating."
13. Shocking some assistants from the audience (make them be the goat).
14. Lighting paper from the fingers.
15. Leakage around condenser plate.
16. Geissler tubes.

Anyone can do the above stunts and more too, with a little practice, but they certainly need the practice. It takes quite a lot of confidence too, to take sparks, but with the practice and remembering not to touch both secondaries or a secondary and a primary at the same time, you're safe. In taking sparks from one secondary with the other grounded the current is not going through you into the floor and then to the ground. It only comes into you and out of you using you and the ground as capacities, and the air, floor and your shoes forming the dielectric of a large condenser. Or in other words, you are very kindly serving as aerial for a capable wireless telegraph transmitter. Thus in number 11 of the program, just explain this while your assistant works the coil to sound something like noise; they do not need to be Morse signals unless there are some in the audience who know the code, and the chances are they will be few.

If direct current is available, it can be run through a reducer to run the coil. A good reducer can be made from two battery zincs or lead plates in an electrolyte of water with a little acid added. Be sure to have fuses on the table with your coil and fuses that will pop on less current than the house fuses so it won't be necessary to delay the game to put new fuses in the house circuits.


Flexible Cord & Handle
Battery
Coil
Take Spark here
Key
Ground
Coil Operated by Battery for Spark eating
Reducer
110 Volts a-c.
Coil Operated from 110 Volt Current with Reducer
+
—
Zinc
Zinc
Acid Water
Reducer
Put very little acid in with Water at first and increase slowly till right current flows
Oxygen
Hydrogen
+
—
Rubber Tube
Bare end of Wire
Acid Water
Electrolytic Cell

PARAPHERNALIA

Rehearse everything once at least before the performance and have a list of what you are going to do on the table in front of you. Otherwise, you will forget half and then won't know when you're done. Practice "spark eating" and develop some new stunts with it if possible.

In the electrolysis experiment, be sure to know which is the positive wire and which is the negative. The positive wire leads to the carbon pole of a dry cell. Less gas forms at the positive pole and is oxygen. The hydrogen, of which there are two parts to each one of oxygen, forms at the negative pole.

In the electrolysis experiment; that is, making hydrogen and oxygen from water by the electric current, you pass direct current through an electrolytic cell, from your batteries, or if there is direct current in the house circuit take it from that, through the reducer. The cell consists of a jar containing slightly acidulated water in which are hung wires from the two terminals of the circuit so that current passes from one to the other through the water. Oxygen will then form in bubbles around one wire and hydrogen around the other, oxygen being formed at the positive terminal or the one which leads from the carbon of the battery. There will be twice as great a volume of hydrogen formed as of oxygen. Collect in test tubes as shown. Try putting a lighted match in each tube after collecting the gas. Of course before inverting the tubes over the terminals they must be first filled with water. The gases will then slowly collect in the tubes and displace the water.

The condenser plate is made of a piece of glass with the foil put on so it sparks around the edges. This and most of the others look better in the dark but the light is needed for several. In the electric ladder bend two stout wires parallel. They must be connected in place of the gap and must be vertical as it is the heated air in rising that causes the spark to climb as heated air is a better conductor than cold air. Many suppose that it is the field of the coil acting as a blowout magnet that causes it, but that can be disproved by mounting the wires horizontally.

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine will be devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART IX.—A TWO-KILOWATT CLOSED CORE TRANSFORMER

PRIMARY

The primary is composed of 250 turns of No. 8 B. & S. gauge double cotton covered magnet wire. Between thirteen and fourteen pounds will be required. The wire will occupy about three and one-half layers. The remaining space in the fourth layer can be filled in by winding with some insulating cloth. Taps are led out on the 175th, the 200th, and the 225th turn. The best way to lead out a tap is to wrap one end of a copper strip (Fig. 100) around the wire and solder it there. The thickness of the strip being negligible it will not interfere with the adjacent turns or layers.

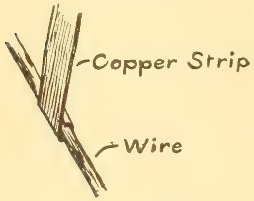


FIG. 100. METHOD OF LEADING OUT TAP

The winding is covered with three or four layers of Empire cloth to give it a finished appearance (Fig. 101). The terminals are both led out through holes in the fibre head. In winding the wire do not forget to allow space for the remaining fibre head which is not yet in position.

SECONDARY

The secondary winding is composed of about 80,000 turns wound in sixteen separate sections or "pies." About twenty-three pounds of No. 32 B. & S. gauge enameled wire will be required.

The sections are wound on a form (Fig. 102) in flat coils. The form is best constructed of brass as wood is liable to shrink and warp. If the flanges were not perfectly true or should warp, the effect would be to make one side of the coil wider than the other and cause the depth from the circumference to the centre to vary considerably.

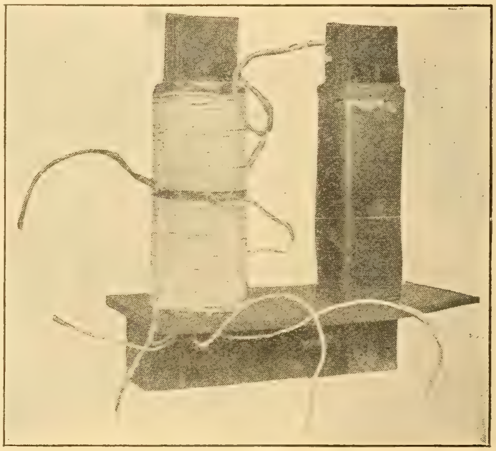


FIG. 101. CORE WITH WINDINGS IN PLACE AND ONE LEG WRAPPED

The flanges are eight inches in diameter and $\frac{1}{8}$ inch thick. The centre is four inches in diameter and $\frac{1}{4}$ inch thick. One side is somewhat smaller than the other so that the taper will facilitate the removal of the finished coil. The form is held together by three threaded binding rods and winged nuts which can be screwed up tightly. The form must be held together firmly or there will be a space between the centre and the flanges through which the wire might slip. Eight saw cuts are made at equal distances in the flanges and the centre of the form so that silk threads can be passed in under and around the completed section before it is removed. (Fig. 102.) The lower ends of the saw cuts are enlarged with a drill so that there will be no difficulty in passing the threads through.

The form is placed in a lathe chuck and the lathe belts arranged to give slow speed without the back gear in mesh. Place the large reel of wire on a rod or support, revolve and allow the wire to run easily.

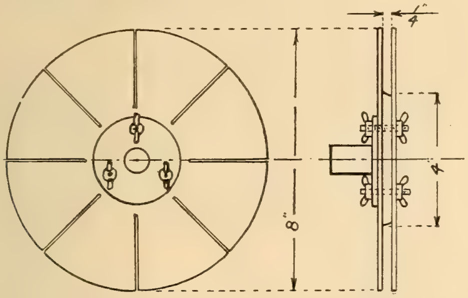


FIG. 102. DETAILS OF FORM

Commence to wind with the form turning away from you. Keep the wire taut and wind on as evenly as possible, trying to prevent the turns from crossing each other. Do not allow any snarls or kinks to be wound in. If the wire should break, splice and *solder* it. Continue to wind until the form is filled to a depth of 1½ inches or is seven inches in diameter.

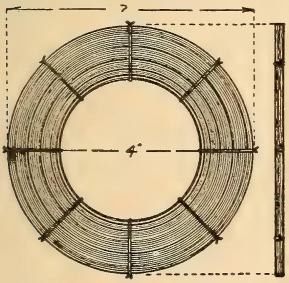


FIG. 103. THE WIRE AS IT COMES FROM THE FORM

Then stop the lathe and break off the wire leaving about six inches for a lead. Pass a piece of strong silk thread through each slot and tie it tightly around the wire coil. (Fig. 103). Remove the form from the lathe and unloosen the winged nuts so that one flange may be taken off. Slide the section out gently onto a piece of stiff cardboard. If the operation is done carefully not a wire will be disturbed. Then slip the cardboard together with the section into a shallow pan containing a molten mixture of beeswax and paraffine. Use good care not to allow the preparation to boil hard or its insulating value will be considerably depreciated.

When all bubbles have ceased to arise lift the coil out on the cardboard and allow it to cool. Treat the remaining fifteen sections in the same manner.

Cut some long strips ¾ inch wide from Empire cloth for use in taping the sections (Fig. 104). Take a coil in the left hand and notice in which direction the wire runs, that is, in which direction the coil is wound. Place one end of the tape under the left hand thumb and with the right hand pass the tape through the hole in the centre and over and around the coil. Lap it each time about one-half of its width. After four or five complete turns have been put on mark an arrow on the tape showing in which direction the section was wound. Then complete the taping of the coil. If the end of a strip is reached before a coil is finished place the end of a new strip on the end of the last and proceed. It is possible by careful taping to allow each terminal of the sections to come out from under the tape in the direction in which it was wound. This will avoid any possible difficulty in assembling and connecting.

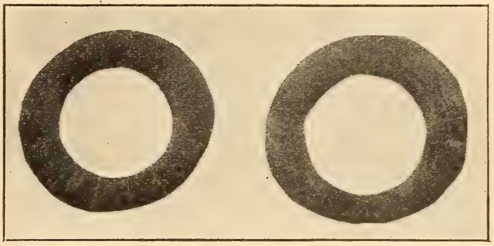


FIG. 104. TAPED SECTIONS

ASSEMBLING

Eighty to one hundred separators (Fig. 105) will be required for insulating the secondary, depending on whether the sections are wound and impregnated carefully or not. They are made of circular disks of blotting paper eight inches in diameter which have been soaked in the molten

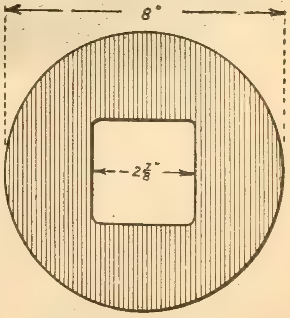


FIG. 105. SEPARATOR

mixture of beeswax and paraffine. Cut a square hole in the centre of each separator which is just large enough to allow it to slip snugly over the Empire cloth on the secondary leg. The separators should be kept in the insulating mixture until they are ready for use. Slip enough of them (about twenty-five) to make a pile one inch high over the secondary leg of the transformer and push them tightly against the fibre head.

The method of connecting the sections is shown diagrammatically in Fig. 106. The coils are turned completely around so that the arrows on every alternate one point in the opposite direction. The inside terminal of one section is connected to the inside terminal of the adjacent section and the outside terminal of that is connected to the outside terminal of the next and so on. The current will then flow through all the coils in the same direction.

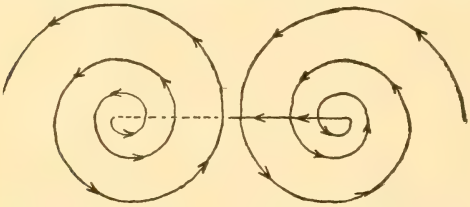


FIG. 106. METHOD OF CONNECTING THE SECTIONS

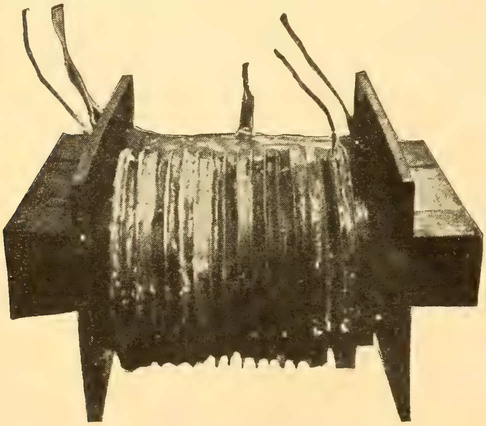


FIG. 107. SECTIONS IN PLACE ON CORE

Group the coils together in pairs placing two separators between each pair. Then connect the inside terminals of each pair together and solder them. In brightening the wires preparatory to soldering them do not scrape with a knife but rub with a piece of fine emery paper. Do not use acid as a flux. Instead use rosin.

Place two coils on the transformer leg and push them snugly against the separators. Then pour some molten beeswax and paraffine into the spaces formed between the Empire cloth and the inside of the section. If the mixture is hot enough it will find its way down through all the cracks and interstices. Then slip on two separators and place two more sections in position. Proceed likewise with all the others. When all are in place (Fig. 107) slip enough separators over the leg to fill up the space between the last section and the fibre head when it is in position. Put the head on and then replace the strips forming the side of the core. Connect and solder the outside ends of the adjacent sections. Solder the terminals of the outside section to two strips of sheet brass about twelve inches long and ¼ inch wide.

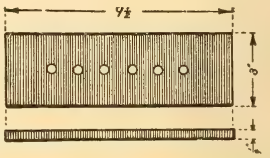


FIG. 108, FIBRE BRIDGE

The core is clamped tightly together by four strips of angle iron each eighteen inches long. Two holes are bored in each and a bolt run through so that when the nuts are tightened it will pull the transformer core tightly together. The tongue is placed opposite the primary. A piece of thin sheet fibre is placed between it and the angle iron wherever they would touch. The distance between the tongue and the ends of the core will vary considerably with the amount of condenser across the secondary. It can be adjusted after the transformer is in use and locked in position by tightening the bolts.

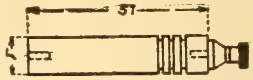


FIG. 109. SECONDARY PILLAR AND TERMINAL

A strip of fibre 9½ inches long and ¼ inch thick forms a bridge (Fig. 108) between the two fibre heads and serves as a support for the primary terminals. Five large binding posts are mounted upon it and connected to the terminals and taps.

The secondary terminals (Fig. 109) are supported upon two hard rubber pillars, five inches long and one inch in diameter. The pillars are fastened in position by a machine screw passing up through the angle iron.

The secondary is wound with several layers of Empire cloth to prevent sparks from jumping into the primary.

The transformer when complete and with the full primary in use will consume about two kilowatts on the 110-volt, 60-cycle current. It will deliver a potential of about 32,000 volts at the secondary and give an intense spark having considerable volume (Fig. 111). I need hardly caution care but it may be well to say that when working with the transformer use all precaution to avoid a shock from the secondary, because such an occurrence would not only feel unpleasant but would be serious and probably fatal.

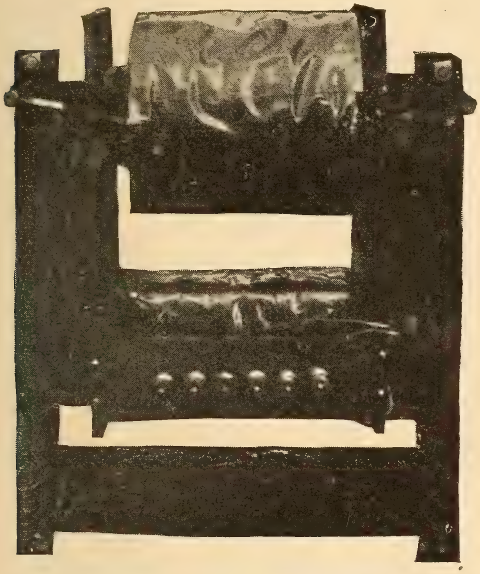


FIG. 110. COMPLETE TRANSFORMER, TOP VIEW

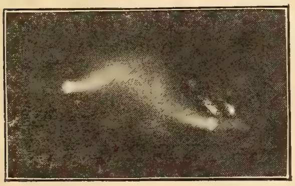


FIG. 111. DISCHARGE OF TRANSFORMER

The wiring diagram is illustrated in Fig. 112. The condenser is connected directly across the secondary terminals. The spark gap is in series with the condenser and the closed circuit of the tuning helix.

The transformer should be placed in a strong wooden box and covered with transformer oil or a mixture of paraffine and resin. The primary terminals can be brought out to binding posts mounted on the cover but the secondary wires should be led out through hard rubber tubes.

The transformer should be raised up off the bottom of the box by wooden blocks placed under the core.

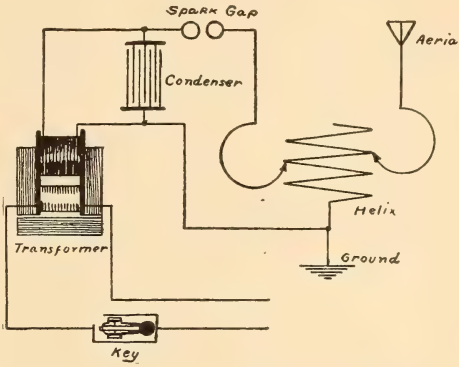


FIG. 112. WIRING DIAGRAM

By varying the number of turns on the primary and using the taps so as to obtain 175, 200 or 225 instead of 250 the capacity of the transformer and its secondary voltage are somewhat increased.

Wireless Association of Montana

Any one in Montana who owns or operates a wireless station is eligible to membership in the Wireless Association recently formed at Butte, Montana. The officers of the Association are: C. E. Spitz, president; H. H. Mees, vice-president; K. T. Sparks, secretary. For further information address the secretary, 927 Utah Ave., Butte, Montana.

Haverhill Wireless Association

The Haverhill (Mass.) Wireless Association was recently formed with the following officers: Wilfred Vigneault, president; Riedel G. Sprague, vice-president; Leon R. Westbrook, secretary and treasurer. Persons in and about Haverhill who operate either a sending or receiving station or both are invited to join.

Wireless Club of Baltimore

An evidence of the widespread popular interest in wireless telegraphy is given in the formation of the Wireless Club of Baltimore. The club meets weekly at the Y. M. C. A. building and the growth in membership has been rapid. Baltimore has probably 100 to 150 private wireless stations conducted by amateurs. They have been talking to one another for some time without seeing one another, and the formation of the club was only a logical outcome. At every meeting there is a lecture by the wireless consultant, who is a man with technical proficiency in electricity and wireless telegraphy. The members, too, give short accounts of their experiments, their triumphs and failures, and occasionally bring out ideas which are almost discoveries. One of the pleasures the members derive is disseminating news which one or more of the number will get from a newspaper office by telephone when there is some important event or development expected. The club solicits its new members by wireless. "Hello, who are you? Do you belong to the wireless club? If not, why not? Aren't you daffy on the subject, too? Hello I catch it, now, yes, you are. Then come to the Y. M. C. A. Friday night. Your instrument sends well, can you hear, yes, all right, I'll expect you." That is the way the membership committee catches a new member by wireless. Here are the officers. President, Walter E. Hartlove; vice-president, Harry W. Richards; secretary, Preston S. Wicks; treasurer, E. R. McLaughlin; consultant, H. E. Kerwan.

Directory of Wireless Stations

With the publication of the government's wireless-telegraph directory, just out, some idea is gained of the extent to which wireless is now used. In this directory, perhaps the most extensive in existence, are listed 1,520 stations. This includes shore stations and ships, but does not take into consideration warships of foreign governments, nor the hundreds of stations equipped and operated by amateurs.

The directory is the work of the bureau of steam engineering of the United States navy. First are listed the wireless telegraph shore stations throughout the world according to country, giving call letters, wave length, power, range and character of station.

There are about 700 shore stations scattered about the globe. Eighty-eight are on the Atlantic and Gulf coasts of the United States, three in the interior, 48 on the Great Lakes, 51 on the Pacific coast and sixteen in Alaska.

As an index, the final list contains the call letters of every station arranged alphabetically. From this operators can distinguish the name of ship or station calling.

Copies of this publication can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a cost of 15 cents each.

Progressive Wireless Club

The Progressive Wireless Club of Poplar Bluff, Missouri, was recently organized with the following officers: George Holt, president; Silas Pace, vice-president; T. E. Story, secretary and treasurer. Four stations are in operation and more are under way. Wireless students in the vicinity are invited to join.

WIRELESS QUERIES

Answered by A. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

Leading In From Aerial; Tubular Type Condenser

Questions.—(A) Would it improve a wireless receiving outfit to have a potentiometer if there are no batteries used? (B) Will high-tension cable be sufficient to lead in for receiving only? (C) I have a tubular type variable condenser and when I move the inside part outward, it only dulls the message. What is the trouble? (D) If more wires are added to an antenna, does it increase the receiving capacity?—G. H. W., Brooklyn, N. Y.

Answers.—(A) No, there would be no need for the potentiometer.

(B) Yes.

(C) Evidently all the capacity of the condenser is required, and it looks as though still more capacity might improve the set.

(D) Yes, but not directly in proportion to the number of wires.

Spark Coil Windings; Condenser; Leyden Jar from Test Tube

Questions.—(A) Must the primary of a spark coil be wound in the opposite direction to the secondary? (B) Is it necessary to have a condenser shunted around the vibrator? Why? (C) Is there danger of winding too much wire on the helix for a two-inch coil? (D) I wish to make Leyden jars out of test tubes, the outside tinfoil, the inside a mixture of salt and water. Can you give me a formula?—S. P., Milwaukee, Wis.

Answers.—(A) No, either may be wound in either direction.

(B) Unless a condenser is used here, the spark length will be small, and the interrupter contacts will be rapidly worn away. At the moment the current is cut off from the coil by the separation of the contact on the spring and that on the adjusting screw, a high electromotive force is developed in the primary, opposite in direction to that in which the battery current had been flowing. This produces the spark at the contacts, and is much higher in value than the voltage of the battery. Being of only momentary duration, it will pass through the condenser, and if allowed to do so, will induce a current in the secondary of much higher voltage than that induced by the battery current itself, and consequently a longer spark will be produced by the secondary. Moreover, there will be less sparking at the interrupter contacts, and they will last longer.

(C) No.

(D) One part of salt to ten of water.

Tuning Transformer

Questions.—(A) Would these be about the right proportions for a tuning transformer—primary 8 by 4¾ inches wound with 223 turns of No. 22 D. C. C. wire, two sliders, secondary 8 by 3¾ inches, wound with 384 turns of No. 29 D. C. C. wire, one slider? (B) What would be the wave length in meters? (C) How far can I expect to receive with this transformer in connection with a silicon detector, 75-ohm receiver and an aerial consisting of two aluminum wires, 50 feet high and 40 feet long?—A. W. H., Johnstown, Pa.

Answers.—(A) Yes, but better results will be obtained by reducing the clearance between the primary and secondary.

(B) Maximum, about 4,000.

(C) An average distance of about 400 miles over water, from high power commercial wireless stations.

QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

Figuring Resistance and Drop

Questions.—(A) The resistance of a certain wire is 4.3 ohms and its length is 20 feet. What is the resistance of 50 yards (150 feet) of this wire? (B) If the resistance of 1,000 feet of copper wire at 20° F. is 100 ohms what will be the resistance per foot at 75° F.? (C) If current is supplied from a center of distribution over a two-wire system to two sixteen-candlepower, 110-volt lamps, No. 1 B. & S. gauge wire being used and the distance is 100 feet, what is the drop in volts? (D) If a group of 100 sixteen-candlepower 110-volt lamps at a distance of 400 feet from the center of distribution are to be supplied with current, what size wire must I use to have but two volts drop?—F. E. K., Asbury Park, N. J.

Answers.—(A) The resistance of a wire increases directly as its length if the cross-sectional area remains the same. The resistance of 50 yards of the wire would, therefore, be 7½ times 4.3 ohms or 32.25 ohms.

(B) In general, pure metals increase or diminish by one per cent their resistance for every 4.5° F. or 2.5° C. up or down the scale. In other words, the resistance of a metal changes four-tenths of one per cent for every degree Centigrade, or 22 hundredths of one per cent for every degree Fahrenheit. This value is called the temperature coefficient for pure metals.

An increase in temperature of 55° F., therefore, increases the resistance of 100 ohms by $(55 \times .0022) \times 100 = 12.1$ ohms, making the total resistance of 1,000 feet of the wire at 75° F. equal to 112.1 ohms or .1121 ohm per foot.

(C) By Ohm's law

$$E = C R.$$

The resistance of one foot of No. 1 B. and S. gauge copper wire (Matthiessen) is .0001237 ohm at 20° C. The resistance of 200 feet is then .02474 ohms. Applying Ohm's law

$$E = 1 \times .02474$$

$$= .02474$$ volt drop, a negligible amount, assuming the current to the two lamps to be one ampere.

(D) Use the formula

$$C. M. = \frac{C \times L \times 10.8}{V}$$

where C. M. = circular mils in wire required

C = current

L = length (two wires)

V = volts loss.

$$\text{Then } C. M. = \frac{50 \times 800 \times 10.8}{2}$$

$$= 216,000$$

Wire required slightly larger than No. 0000. The National Electrical Code requires No. 5 wire for 54 amperes, but does not take into consideration the voltage drop.

Residual Magnetism

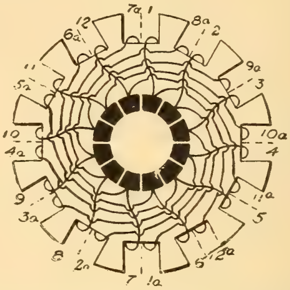
Question.—What is meant by residual magnetism?—C. F. J., West Baden, Indiana.

Answer.—If a bar of iron is temporarily made a magnet by winding a number of turns of wire about it and passing a current through the wire, there will still remain in the iron a small amount of magnetism after the current has ceased to flow through the coil. This remaining magnetic charge is called residual magnetism. The presence of residual magnetism in the pole pieces of a dynamo enables the machine to "build up." The magnetism retained by a piece of iron or steel depends upon the retentivity of the metal. The retentivity of hard-tempered steel is large, that of soft wrought iron small. The harder the steel the greater the retentivity and the amount of residual magnetism it will have after being magnetized by a current carrying coil or permanent magnet.

Winding 12-Slot Armature

Question—Will you please explain by diagram how to wind a 12-slot drum armature?—J. W. B., Jr., Spokane, Wash.

Answer.—See diagram.



ARMATURE WINDING DIAGRAM

Principle of Vacuum Cleaner Operation

Question.—Please explain how a vacuum cleaner works.—R. I. B., Grand Rapids, Mich.

Answer.—In one make of cleaner a motor direct connected to a centrifugal suction fan produces the suction. The motor is situated outside the fan chamber. The mouth of the "sucker" which runs over the floor is fitted, a few inches back from the opening, with a coarse wire screen to stop the coarser dirt, a drawer being provided for the dirt to drop in. The finer dust passing through the fan is blown into a bag of stout cloth arranged in layers so that the air must pass through these layers and be cleaned before being set free. The strainer cloth is so arranged as to be a single piece. To remove the dirt the cylinder which holds the dirt sack is taken off the pipe leading to it, the top removed and the sack and dirt taken out. In one type of sweeper this sack is suspended on the handle used to propel the cleaner over the floor.

Direction to Wind Secondary of an Induction Coil

Question.—Should the secondary of an induction coil be wound in the same direction as the primary?—A. W. F., Chester, Pa.

Answer.—The secondary may be wound in either direction without reference to the primary winding.

To Find Frequency of Alternator

Question.—Please give rule for finding the frequency of an alternator.—B. B., Greenville, Mich.

Answer.—Divide the revolutions per minute by 60 and multiply the quotient by the number of pairs of poles in the field.

Compensation for Patent Infringement

By OBED C. BILLMAN, LL. B., M. P. L.

IN GENERAL.—The patentee can recover, as a compensation for the invasion of his rights, the damages he has suffered through the infringement, and, under certain circumstances, the profits made by the infringer.

DAMAGES—IN GENERAL.—There is no rule of damages which will apply to all cases. But the damages must be actual, and not speculative or exemplary.

LICENSE FEE AS MEASURE OF DAMAGES.—Sales of licenses of machines or established royalties constitute the primary or true criterion of damages. But this rule is applicable only where the royalty is the fixed and established price at which a license is granted to use the particular patent, without other inducements, and under circumstances fairly similar. The established license fee is not the proper measure of damages where the infringement is only a part of the invention for which such license fee is charged, unless such license fee is apportioned, except where the portions not infringed are merely structural and are included within those infringed. The license fee must be for the infringed rights, and not for other rights under the patent. So where the patented improvement has been used only to a limited extent and for a short time, the license fee is not the proper measure of damages, but a smaller sum should be found as the damages sustained. The license fee is simply evidence of damages, and not an absolute and invariable test.

WHERE TEST OF LICENSE FEE IS INAPPLICABLE.—*Compensation for Actual Loss.*—Where the test of a license fee cannot be applied to determine the amount of damages the patentee will be entitled to an amount which will compensate him for the injury to which he has been subjected by the piracy, and the jury may consider what would be a reasonable royalty under all the circumstances. What the plaintiff has lost, not what the defendant has gained, is the measure of damages. The damages recoverable are, of course, limited to such as are the proximate and not the remote result of the infringement, and should be estimated not for the whole term of the patent, but only for the period of the infringement. No damages are recoverable for the use of the invention prior to the issuance of the patent upon which suit is brought. The profits lost by the patentee by reason of the infringement are a proper element of damages. Speculative profits cannot be recovered. It must be proved with reasonable certainty that the profits claimed would have been realized except for the infringement. The burden of proving damage is upon the plaintiff, and in the absence of sufficient proof only nominal damages may be recovered. The ordinary rules of evidence are applicable to this subject. Full damages should be given only for full infringement according to the nature of the patent. Infringement by selling and infringement by using the patented article are essentially different. For the mere making of a patented article without either selling or using it the damages should be nominal. Counsel fees and expenses in prosecuting the action cannot be included in the verdict.

Infringement in Conjunction with Other Devices.—Where the patent covers only part of a device, or is for a mere improvement, an infringer is liable only for so much of the value as is due to the patented improvement. But when the entire commercial value of a device depends upon the patented part, no deduction is to be made for the other parts of the device.

Profits of Defendant as Measure of Damages—The defendant's profits can be taken as the measure of damages in an action at law only under peculiar circumstances, and where no other rule can be applied.

INCREASE OF DAMAGES.—By express statutory provision, whenever a verdict is rendered for the plaintiff the court may enter judgment thereon in any sum above the amount found by the verdict as the actual damage, according to the circumstances of the case, not exceeding three times the verdict. This provision does not extend to profits recoverable in equity. It is in lieu of the right of the jury to award exemplary damages, and takes away that right.

When Increase Will be Added.—The court will increase the damages when the infringement is deliberate and intentional, or wanton and persistent, but ordinarily not otherwise. The increase or non-increase of damages rests in the discretion of the court.

FORFEITURE OF DAMAGES BY FAILURE TO MARK IN ACCORDANCE WITH STATUTE.—The statute provided that in case of failure to mark an article "patented," as prescribed by the statute, no damages shall be recovered for infringement except on proof that the defendant was duly notified of the infringement.

MITIGATION OF DAMAGES.—Damages may be mitigated by good faith and ignorance of the existence of a patent upon the part of the infringer, or by the conduct of the patentee whereby the infringer was misled or the recovery of full damages is otherwise rendered inequitable or unjust. At least, under such circumstances, exemplary or increased damages should not be awarded, though compensation for the actual damages suffered may doubtless be recovered.

INTEREST ON DAMAGES.—Where a royalty is taken as the measure of damages, interest may be allowed from the date of infringement, and generally the jury, in estimating damages, may, in its discretion, take into account the interest and allow it as damages.

NEW BOOKS

MAGNETS AND MAGNETISM SIMPLY EXPLAINED. By Alfred W. Marshall, A. M., I. E. E., M. I. Mech. E. New York: Spon and Chamberlain. 1910. 89 pages with 49 illustrations. Price, 25 cents.

This book gives the general properties and theory of magnets. The explanation is without mathematics or figures.

TELEPHONE CONSTRUCTION, INSTALLATION, WIRING, OPERATION AND MAINTENANCE. By W. H. Radcliffe, E. E., and H. C. Cushing, Jr., E. E. New York: Norman W. Henley Publishing Co. 1908. 171 pages with 125 illustrations. Price, $1.00.

A work for the amateur, the wireman or the engineer who desires to establish telephonic communication between the rooms of his home, office or shop; also for the contractor who wishes to build small exchanges in factories, mills, or small towns.

PRACTICAL ELECTROPLATING. By George Gentry. New York: Spon and Chamberlain. 1910. 106 pages and 41 illustrations. Price, 50 cents.

A book intended to describe the principles and processes of electroplating in such a way as to appeal to amateurs and beginners.

ELECTRICITY IN FACTORIES AND WORKSHOPS. By A. P. Haslam, M. I. E. E. New York: Norman W. Henley Publishing Company. 1909. 312 pages and 70 illustrations. Price, $2.50.

This book shows what a convenience the electric motor in its various forms has become to the modern manufacturer.

WIRING A HOUSE. By Herbert Pratt. New York: Norman W. Henley Publishing Company. 1909. 21 pages and six illustrations. Price, 25 cents.

A book of useful information to the electrician on how to lay out systematically and install electric wiring in a residence.

WIRELESS TELEPHONES AND HOW THEY WORK. By James Erskine-Murray, D. Sc. New York: Norman W. Henley Publishing Co. 1910. 66 pages with 17 illustrations. Price, $ 1.00.

This book is intended for the use of the non-technical reader and gives a clear, intelligible account of wireless telephone systems now in various degrees of development.

WORKSHOP WRINKLES AND RECIPES. By Percival Marshall. London: Percival Marshall & Co. (New York: Spon and Chamberlain). 1909. 96 pages with 44 illustrations. Price 50 cents.

A collection of useful workshop hints on mechanics and electricity for the amateur mechanic who is familiar with the ordinary run of workshop operations.

N. E. L. A. "Proceedings"

The National Electric Light Association is now issuing to its members the annual "Proceedings". These two volumes include the report of the Thirty-third Convention held at St. Louis last May, and mark the twenty-fifth anniversary of the Association. The volumes include 2,070 pages and 483 illustrations. Among the latter are a fine portrait of President Frueauff and several elaborate colored engravings in the paper on Street Arcs, by Mr. Ryan. The Proceedings embrace some 70 papers and committee reports, all of which are carefully indexed and an abstract is given of each paper or report for ready references. A year ago the edition was 4,500 sets. This year, owing to the rapid increase in membership, the edition is not less than 7,000 sets, and it is interesting to know that these represent about 28 tons of printed matter. Many of the State and Company sections are now so large that these books are delivered to the local secretaries, in bulk, by freight or express.

ON POLYPHASE SUBJECTS

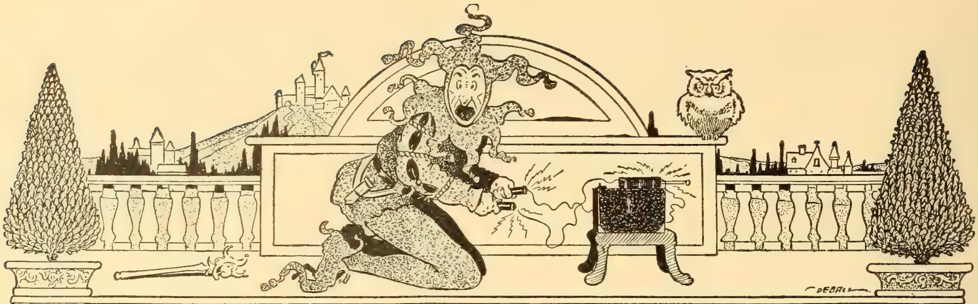
Electricity by the Wagon Load For originality and persistence a St. Paul, Minnesota, man should be awarded first prize. Eleven years ago he built a fine home some distance beyond the electric lighting limits and although informed that it would be years before lighting mains would be run into the neighborhood he wired his house. He owned also what few men then possessed, an electric automobile. Each day for years this machine has taken him to his work and is then placed where, in accordance with his orders, it can be "loaded to the brim with electricity." When he reaches home in the afternoon the automobile battery is connected to the service switch of the house and the electric lights are ready to be turned on.

Vacuum Cleaned Car Tracks When one of our comic papers pictured a brigade of street cleaners as using crumb brushes, crumb trays and magnifying glasses, the cartoon was enjoyed because of its striking contrast with the street conditions then existing in so many American cities. Yet the tendency is towards just such an exacting cleanliness, and happily so, as the old plan of cleaning streets thoroughly once before every election is hardly conducive to the general health of the community. Having much shorter and narrower streets in proportion to their population than we do in America, it is logical that European cities should excel in this phase of cleanliness and they have been the first to introduce electrical vacuum cleaners into the street service.

A novel type of these is now in use at Hanover for removing the dust and dirt which clogs the rails of the street cars. This equipment consists of an electrically driven vacuum cleaner mounted on a special trolley car which has a sprinkler for moistening the rails and laying the dust before the vacuum tip comes along; also a large tank for receiving the dirt. This rail cleaning car which requires no attendant besides the motorman, cleans about 45 miles of track daily.

The Institute Edison Medal The Edison Medal Association which was formed by the friends and admirers of Mr. Thomas A. Edison to found a gold medal in the American Institute of Electrical Engineers, celebrating the invention of the incandescent lamp and 25 years of its successful use has just closed up its accounts. The association began its work five years ago and raised a fund of somewhat over $7,600 for the purpose. Of this account $5,000 was placed in the hands of the Institute for the Medal Award Fund. The contract for the design of the medal was made with Mr. James Earle Frazer, the well known sculptor, who, owing to the change in the deed of gift, was called upon to make two separate designs and who received about $1,500 for his work. The medal was at first to be awarded to students of electrical engineering but this was changed and only one award was made to a student competing, the amount being $150 without a medal but with a special certificate. Under the new deed of gift, the medal is awarded for meritorious achievement in electricity, and this year Professor Elihu Thomson was the first recipient.

A Good Investment If it were proven to you that a small sum of money in the form of an investment would yield two or three times its value at once you would not hesitate to jump at the chance. Such a form of speculation is represented every time a building is wired. If you still doubt, consider a six-room house which in some localities can be wired for about $60. From the real estate man's point of view he will be able to dispose of the improved property at an advance of from $150 to $200 over the former price. Setting aside all other appeals such as convenience, safety, etc., to induce an owner or landlord to use electric lighting the investment idea ought to win consideration.



SHORT CIRCUITS

A man down East by the name of Moon got married and that was a change of the Moon. In due time his wife presented him a daughter; and that was a new Moon; then he went down town and got drunk for joy, and that was a full Moon; when he started home he had only 25 cents, and that was the last quarter. His mother-in-law met him at the door with a rolling pin, and that was a total eclipse.

* * *

A young lady who is teaching a class of small boys in Sunday School desired to impress on them the meaning of returning thanks before a meal. Turning to one of the class whose father was a deacon in the church, she asked him: "William what is the first thing your father says when he sits down to the table?" "He says, 'Go slow with the butter, kids; it's forty cents a pound'," replied the youngster.

* * *

A gentleman in a restaurant had waited patiently for fifteen minutes to get a chance to use the telephone. The gentleman who was using it held the receiver to his ear, but had not spoken at all and finally in desperation the man who was waiting politely said, "Pardon me, but may I use the telephone for a moment? I see you have not got your party." "You are mistaken," said the other. "I am talking to my wife."

* * *

POPULATION OF THE WORLD

Actors who played with Booth and Barrett	11,456,189
People who knew you when you were poor	78,546,987
Oldest inhabitants	56,187,354
Assorted liars	356,456,100
People with a grievance	108,567,876
People who remembered you when you were "so high"	76,345,567
"Old Subscribers"	64,456,732
Damphools (all varieties)	763,453,657
	1,515,470,462

* * *

On a starlit night an Irishman was rowing two Englishmen across a river.

"Say, Pat," said one of the men, "Do you know anything about astrology?"

"I do not," replied Pat.

"Then the best part of your life has been lost," said the Englishman.

The other passenger inquired:

"Pat do you know anything about physiology?"

"I do not," was Pat's response.

"Then that's the best part of your life lost," he answered.

Just then a squall struck the boat and all three were thrown into the water.

"Say, fellows, do yez know anything about swimin'ology?"

"No," gasped both the Englishmen as they floundered in the water.

"Thin, begorra, both of yiz lives is lost," said Pat, as he struck out for the shore.—National Food Magazine.

Flushed and breathless, the well-dressed young man picked up the hat he had been chasing down the street and leaned against a lamp post to rest. Another, also breathing heavily, came running up and took the hat out of his hand. "I'm much obliged," he said. "For what?" "This is my hat." "Where is mine then?" "Hanging behind you, at the end of a string."

* * *

"Our fleet of torpedo destroyers seems to have stirred up our friend, the enemy," remarked the naval chief of one great power.

"Yes," replied his assistant, "it is said they will build a fleet of torpedo destroyer exterminators now."

"Let 'em; we'll build a fleet of torpedo destroyer exterminator annihilators."

* * *

Merton—I'm going in for athletics now.
Burton—Yes?
Merton—I roll all of my cigarettes myself now.

* * *

Mrs. Johnson had gone away from home, leaving Mr. Johnson disconsolate. On arriving at her destination, she missed her gold lace pin, and wrote her servant girl, asking the girl to let her know if she found anything on the dining-room floor.

The servant wrote as follows: "When sweeping the dining-room floor this morning, I found thirty matches, four corks and a pack of cards."

* * *

A Harvard football player after an unfortunate encounter with Yale thought he would escape the public eye by cutting across the fields. A big bull, which looked as if it could do good work in a mass play, bobbed up and cast an evil eye upon the jersey of Harvard crimson.

"Why didn't I take my father's advice," the young man reflected, "and go to Yale! This is no place for a Harvard man."

* * *

"Mamma," said little Ethel, with a discouraged look on her face, "I ain't going to school any more."

"Why, my dearie, what's the matter?" the mother gently inquired.

"'Cause it ain't no use at all. I can never learn to spell. The teacher keeps changing the words on me all the time."

* * *

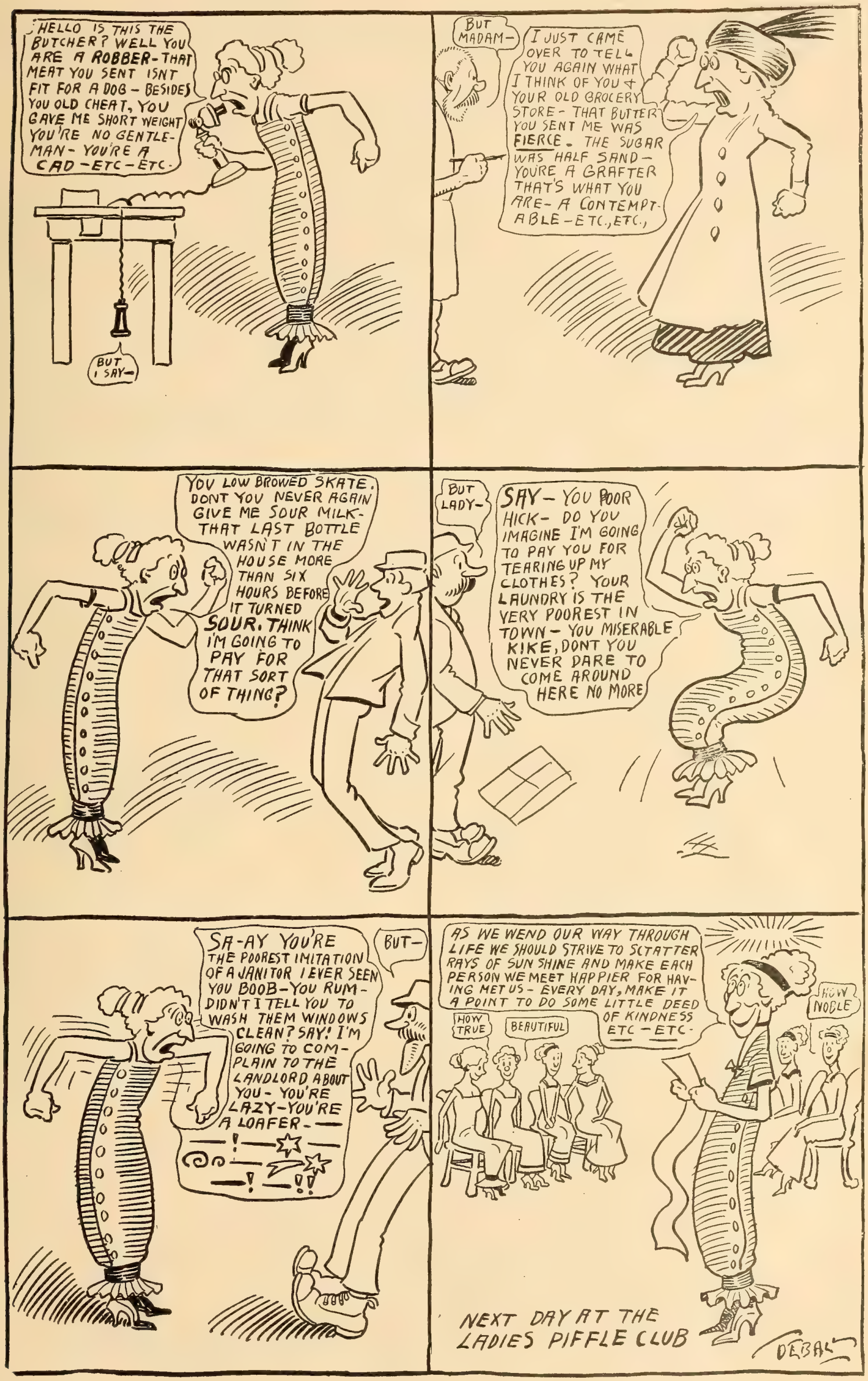
An old dweller in the hills of Arkansas who had lived all his life in one township recently took a trip to Little Rock, forty miles away, and was full of his subject on his return.

"By jing!" said he, in voicing his impressions, "if this hyar world's as big crossways as hit is f'm hyar to Little Rock hit's shore a whopper!"

* * *

"What state do we live in?" asked the teacher in the primary geography class.

And little Elmer, thinking of his Sunday-school catechism, promptly replied: "In a state of sin and misery."


HELLO IS THIS THE BUTCHER? WELL YOU ARE A ROBBER - THAT MEAT YOU SENT ISNT FIT FOR A DOG - BESIDES YOU OLD CHEAT, YOU GAVE ME SHORT WEIGHT YOU'RE NO GENTLEMAN - YOU'RE A CAD - ETC - ETC.
BUT I SAY -
BUT MADAM -
I JUST CAME OVER TO TELL YOU AGAIN WHAT I THINK OF YOU & YOUR OLD GROCERY STORE - THAT BUTTER YOU SENT ME WAS FIERCE. THE SUGAR WAS HALF SAND - YOURE A GRAFTER THAT'S WHAT YOU ARE - A CONTEMPTABLE - ETC., ETC.,
YOU LOW BROWED SKATE. DONT YOU NEVER AGAIN GIVE ME SOUR MILK - THAT LAST BOTTLE WASN'T IN THE HOUSE MORE THAN SIX HOURS BEFORE IT TURNED SOUR. THINK I'M GOING TO PAY FOR THAT SORT OF THING?
BUT LADY -
SAY - YOU POOR HICK - DO YOU IMAGINE I'M GOING TO PAY YOU FOR TEARING UP MY CLOTHES? YOUR LAUNDRY IS THE VERY POOREST IN TOWN - YOU MISERABLE KIKE, DONT YOU NEVER DARE TO COME AROUND HERE NO MORE
SA-AY YOU'RE THE POOREST IMITATION OF A JANITOR I EVER SEEN YOU BOOB - YOU RUM - DIDN'T I TELL YOU TO WASH THEM WINDOWS CLEAN? SAY! I'M GOING TO COMPLAIN TO THE LANDLORD ABOUT YOU - YOU'RE LAZY - YOU'RE A LOAFER - —— ! —— !! —— ! ——
BUT -
AS WE WEND OUR WAY THROUGH LIFE WE SHOULD STRIVE TO SCATTER RAYS OF SUN SHINE AND MAKE EACH PERSON WE MEET HAPPIER FOR HAVING MET US - EVERY DAY, MAKE IT A POINT TO DO SOME LITTLE DEED OF KINDNESS ETC - ETC -
HOW TRUE
BEAUTIFUL
HOW NOBLE
NEXT DAY AT THE LADIES PIFFLE CLUB
DEBAL

COMMON ELECTRICAL TERMS DEFINED

In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.

Circuit, Internal.—That part of the electric circuit included within the source of current supply.

Circuit, Line.—That part of a telegraph circuit carried on the poles.

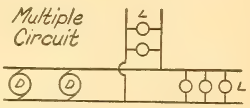
Circuit, Local.—A circuit supplied by a battery or auxiliary source apart from the main source and brought into operation by a main line relay. A notable example is the circuit of the ordinary telegraph sounder.

Circuit, Magnetic.—The path through which the lines of magnetic force pass in a magnet, generator or motor frame, or other magnetic or electromagnetic devices.

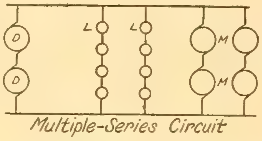
Circuit, Main.—The circuit supplied by the main battery in distinction to that operated by the local battery.

Circuit, Metallic.—A circuit in which metal conductors are employed throughout; that is, in which the earth forms no part of the path of the current.

Circuit, Multiple.—An arrangement of several sources of electrical energy or of receiving devices so that the positive poles are all connected to one conductor and the negative poles to a negative conductor. (See cut.)

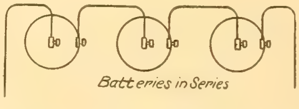

Multiple Circuit

Circuit, Multiple-Series.—A circuit in which sources of electrical energy such as batteries or dynamos; or receiving devices, as lamps or motors, are connected in a number of groups in series and these separate groups then connected in multiple or parallel. (See cut.)

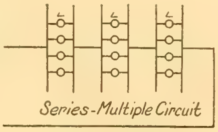

Multiple-Series Circuit

Circuit, Open.—A circuit in which the continuity of the conductor is broken, in short, a broken circuit.

Circuit, Series.—The arrangement of several sources of electrical energy or receiving devices so that current which passes through one passes successively through each of the others from the first to the last. (See cut.)


Batteries in Series

Circuit, Series-Multiple.—A circuit in which sources of electrical energy or receiving devices are first connected in parallel or multiple groups and these groups then connected in series. (See cut.)


Series-Multiple Circuit

Circuit, Short.—A by-path of small resistance by which the current passes back to the source, without going through all of the main circuit.

Circuit, Shunt.—An additional circuit taken off a wire and again returning to it, the current dividing so that part still flows in the original wire and part over the shunt wire in proportion to the resistance of each.

Circular Mil.—The area of a circle one mil in diameter. Equal to .7854 of a square mil. Used in measuring the cross-section of wires and cables. A mil (length) is 0.001 inch.

Clark's Compound.—A cement used for the outside of the sheath of telegraph cables. Prepared, by weight, as follows: mineral pitch, 65 parts; silica, 30 parts; tar, 5 parts.

Clearance Space.—The space in a dynamo or motor between the faces of the pole pieces and the armature.

Cleats.—Blocks, usually of porcelain, for supporting electric wires on the surface wired over. Often made of hard wood where used to install wires of very low voltage systems.

Clock, Electric.—A clock wound and regulated by electric current.

Clock, Master.—In a system of clocks the clock which controls all the others, being connected to each by an electric circuit. Each clock is provided with proper magnets, and motors in some instances, for regulating and winding purposes, these devices being operated by the master clock.

Clock, Self-winding, Electric.—A clock wound periodically by a motor or electromagnet, the circuit closing switch being a part of the clock mechanism.

Closed Circuit Battery.—See Battery, Closed Circuit.

Closed Magnetic Circuit.—A circuit in which magnetic lines of force follow a path of metal throughout their course. The core of a ring or closed-core type of transformer is an example of such a circuit.

Clutch.—In an arc lamp a plate or bar through which a hole is made for the upper carbon to pass. One end of this plate is raised and lowered by an electromagnet in the lamp thus allowing the carbon to feed by dropping through. This is what occurs when an arc lamp flickers.

Clutch, Electromagnetic.—A device for connecting a shaft with a source of rotation, electric current being used to cause the connection. In one form it consists of two flat faces on the ends of the shafts to be joined. In a groove of one face is a coil of wire. When current is sent through this coil the face of the disk becomes a magnet, attracts the other disk and causes the two shafts to rotate as one.

Code, Cipher.—In cable transmission words or phrases are often used to express whole sentences. This makes messages much shorter and affords a means of secrecy. In manufacturers' catalogues a code word is frequently given to each device, one manufacturer, for example using the word "fishwoman" to designate an Edison, porcelain cap, fusible attachment plug.

May We Send You Free Samples

To Prove That You Can Artistically Color and Finish Any Kind of Wood About the Home

YOU can produce any desired shade and effect. The expense is slight—the work easy and simple. First apply Johnson's Wood Dye—made in 14 shades as listed below. Over the Dye lightly apply Johnson's Prepared Wax—and you have a beautiful, rich, subdued finish that will not mar or show scratches.

Johnson's Wood Dye must not be confused with colored varnishes or stains, which merely coat the surface of the wood hiding the natural grain beauty. Johnson's Wood Dye is not a mere stain—not merely a surface dressing—it is a deep-seated dye which goes to the very heart of the wood and stays there, fixing a rich and permanent color.

Johnson's Wood Dye

is made in fourteen attractive shades, as follows:

No. 126 *Light Oak*
No. 123 *Dark Oak*
No. 125 *Mission Oak*
No. 140 *Manilla Oak*
No. 110 *Bog Oak*
No. 128 *Light Mahogany*
No. 129 *Dark Mahogany*
No. 130 *Weathered Oak*
No. 131 *Brown Weathered Oak*
No. 132 *Green Weathered Oak*
No. 121 *Moss Green*
No. 122 *Forest Green*
No. 172 *Flemish Oak*
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Pints, 50 *cents each*

Johnson's Prepared Wax

dries quickly over Dye or any other finish so that it may be brought to a beautiful, dull, artistic finish. It should be used for all woodwork, floors and furniture including pianos and is just the preparation for Mission furniture.

Johnson's Under-Lac

is not a common varnish—but a thin, elastic spirit preparation superior to shellac or ordinary varnish, and is to be used over Wood Dye where a higher gloss than a wax finish is desired, drying hard in half an hour. Best preparation for linoleum and oilcloth, bringing out the pattern as glossy as new. Gallons $2.50—smaller sizes down to half pints.

Fill out the coupon for free samples and booklet

S. C. Johnson & Son
"The Wood Finishing Authorities"
Racine, Wisconsin

Free Sample Coupon

Please send me free samples of Wood Dye, Shade No.......... Prepared Wax and Under-Lac—also Booklet. If samples are found satisfactory will ask my dealer to supply me.

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Regardless of what mechanical appliance you wish to operate, we can supply you with a Fort Wayne motor particularly adapted to your requirements.

No one motor ever built can run all kinds of devices equally well, so we have developed a variety of types to meet all conditions. For years we have been making the motors used on the leading vacuum cleaners, water pumps, meat grinders, washing machines, vibrators, etc. Tell us what you want to run and we will advise you what kind of a motor it will need and how much it will cost to buy and operate it.

Our new bulletin 1122 contains descriptions and illustrations of some twenty applications which have saved time and money for Manufacturers, Merchants, Doctors, Dentists, Housewives, etc. We want to mail you a copy—FREE. It will pay you to send for this bulletin and read it before you buy motors of any kind.

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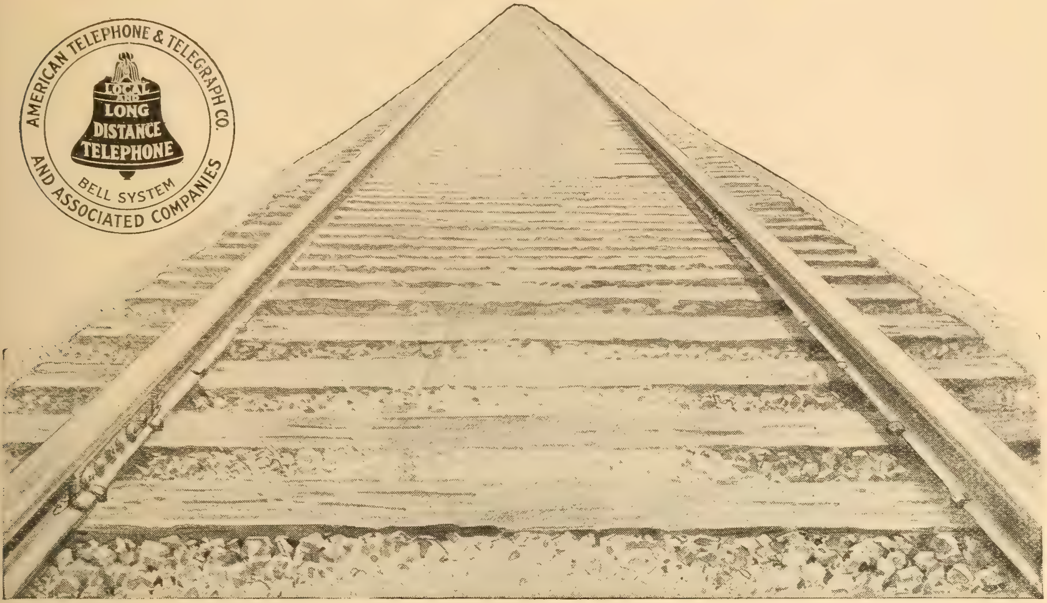
Most Large Cities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LOCAL AND LONG DISTANCE TELEPHONE
BELL SYSTEM
AND ASSOCIATED COMPANIES

"The Clear Track"

Two men a thousand miles apart talk to each other by telephone without leaving their desks.

Two wires of copper form the track over which the talk travels from point to point throughout a continent.

Moving along one railroad track at the same time are scores of trains carrying thousands of passengers. The telephone track must be clear from end to end to carry the voice of one customer.

The Bell system has more than ten million miles of wire and reaches over five million telephones. This system is operated by a force of one hundred thousand people and makes seven billion connections a year—twenty million "clear tracks" a day for the local and long distance communication of the American people.

The efficiency of the Bell system depends upon "One System, One Policy, Universal Service."

**AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES**

The Honest Light

In one way most electric lamps are dishonest in that they consume three times as much current as is necessary. They were good—in their day but—time has passed and improvements have been made so that lamps haven't the same relative value they once had.

Before the Mazda lamp was perfected the carbon lamp was considered efficient, now however, the

Mazda Lamp

gives two and a-half times as much light and consumes no more current.

To operate a carbon lamp is really being dishonest to yourself. You are not getting what you might for the price you pay. Not only does the Mazda lamp give an honest quantity but it also gives an honest daylight quality of light.

Ask any of the member companies the why of these facts.

National Electric Lamp Association

CLEVELAND

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National Electric Lamp Association

CLEVELAND

Call upon any of them for your lamp supplies.

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THE BRILLIANT ELECTRIC CO., Cleveland, O.

BRYAN-MARSH COMPANY, Central Falls, R. I.—Chicago, Ill.

THE BUCKEYE ELECTRIC CO. Cleveland, O.

THE BUCKEYE ELECTRIC LAMP CO., City of Mexico

THE CLEVELAND MINIA. LAMP CO., Cleveland, O.

THE COLONIAL ELECTRIC CO., Warren, O.

THE COLUMBIA INC. LAMP CO. St. Louis, Mo.

ECONOMICAL ELECTRIC LAMP CO., New York City

THE FOSTORIA INC. LAMP CO., Fostoria, O.

THE GENERAL INC. LAMP CO., Cleveland, O.

THE JAEGER MINIA. LAMP MFG. CO., New York City

THE MONARCH INC. LAMP CO., Chicago, Ill.

THE WARREN ELECTRIC & SPECIALTY CO., Warren, O.

NEW YORK & OHIO COMPANY, Warren, O.

THE SHELBY ELECTRIC CO., Shelby, O.

THE STANDARD ELECTRICAL MFG. CO., Warren, O.

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SUNBEAM INC. LAMP CO., Chicago, Ill.—New York City

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The only storage battery that has made good in the electric vehicle field is the Storage Battery for you, no matter what your requirements are. Four of the foremost makes of electric vehicles—Detroit, Bailey, Baker and Waverly—are now regularly equipped with

The New Edison Storage Battery

and here are some of the remarkable records these cars have made:

In a series of 12 tests recently conducted by Thomas A. Edison, with cars equipped with the new Edison Storage Battery, over average country roads of New York and New Jersey, the average mileage was 127¼ miles on a single charge of the battery. The minimum mileage obtained in these tests was 102 miles, due to heavy head-winds and 15% grades. The maximum mileage was 172 1/10 miles.

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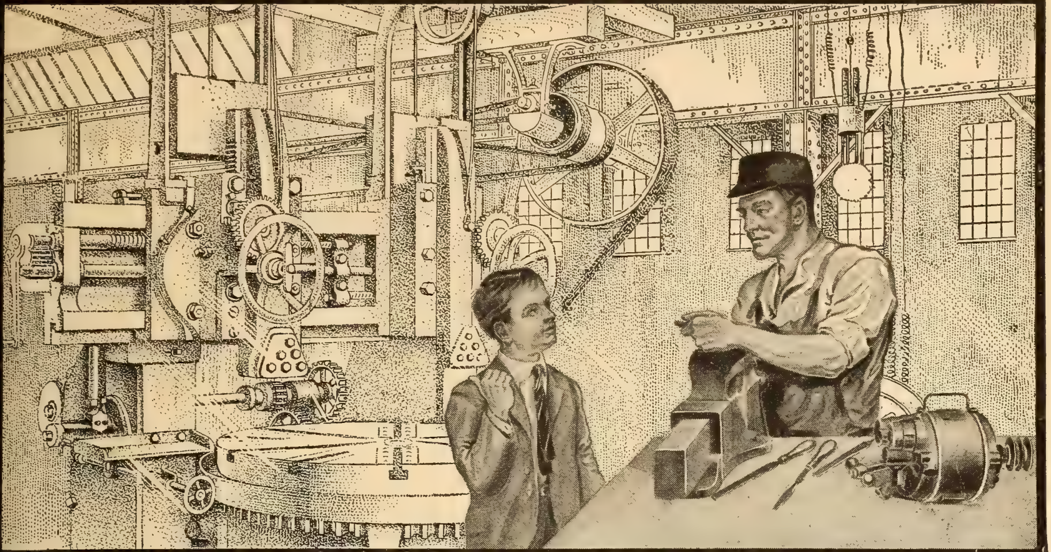
No other storage battery can show records like these—because no other storage battery is built like the Edison. The Edison is **radically different.**

There is no lead or acid in its construction. The plates are nickel and iron in an alkaline (potash) solution. It can't sulphate or deteriorate. It is not injured by overcharging, by too rapid discharge, by complete discharge, or by standing idle for any period of time. A lead battery of capacity equal to that of the Edison weighs almost twice as much.

The Edison requires far less care and attention and its life is many times that of any other storage battery.

No matter what your battery requirements are, write us today for full particulars of the Edison.

Edison Storage Battery Co., 117 Lakeside Ave., Orange, N.J.



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Have you the training to so plan work that the best results can be secured at the least expense?

Could you hold your own among trained men—the men who get big salaries?

If not, how can you expect advancement?

If you have real ambition—a burning desire to advance—we can help you to a better position and salary. Every month there are received at the I. C. S. upward of 300 voluntary letters telling of positions bettered and salaries increased through study of I. C. S. Courses. Advancement is just a matter of training: And training young men for advancement has been the business of the I. C. S. for 19 years.

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Please explain, without further obligation on my part, how I can qualify for a larger salary and advancement to the position, trade, or profession before which I have marked **X**.

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2-TICKLE-U, 3c. STIX, STOCKTON, CAL.

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DON'T ACCEPT AN AGENCY UNTIL YOU get my samples and particulars. Money-makers. Address SAYMAN, 706 Sayman Bldg., St. Louis, Mo.

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125 PER CENT PROFIT TO YOU, 97 PER cent saving to customer. Hand rope machine makes better, stronger rope than factory. NEW, ABSOLUTELY no competition. Farmers, ranchers, factories, boats, builders, liveries, saddlers, stores buy on sight. One man sold 10 first 20 minutes ($25 profit), another 100 weekly. Appoint sub-agents. Act now for ground floor contract. Chicago Specialty Factories, "Dept. N," 40 Michigan Ave., Chicago.

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SEND FOR CIRCULAR DESCRIBING OUR new Mail Order Plan. Dept. E., Box 283, Scranton, Pa.

IN THREE YEARS I MADE $20,000 IN MAIL-order business. FREE booklet explains system. Send for it. Haynes, Marion, Ky.

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WHILE THEY LAST—MOST POWERFUL vest pocket flash lights made. Nickeled case, Osram bulb, Merchlor battery, $1.25 prepaid. Throw light fifty feet. Rex Bromide Co., Dept. G., Lincoln Park Station, Chicago.

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GET A BETTER PLACE—UNCLE SAM IS best employer; pay is high and sure; hours short; places permanent; promotions regular; vacations with pay; thousands of vacancies every month; all kinds of pleasant work everywhere; no lay-offs; no pull needed, common education sufficient. Ask for free Booklet 50, giving full particulars and explaining my offer of position or money back. Earl Hopkins, Washington, D. C.

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SAVE TIME AND MONEY BY USING A SAFEty Razor Guard on your razor. Cannot cut yourself, fits any razor, guaranteed satisfactory, 50c postpaid. Richmond Razor Co., Box 204, Oak Park, Ill.

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BETTER DROP A POSTAL TODAY FOR Catalog of Cameras, Supplies, Developing, Printing, Enlarging, etc. Valuable Exposure Meter included, ten cents; Calendar Free this month, if requested. Rex Bromide Co., Dept. E., Lincoln Park Station, Chicago.

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MODELS MADE FOR INVENTORS. LOW prices. S. H. Merryman, Towson, Md.

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C. L. PARKER, PATENT ATTORNEY, EX-Examiner U. S. Patent Office, 912 G St., Washington, D. C., Inventors' handbook, "Protecting, Exploiting and Selling Inventions" sent free upon request.

PATENTS

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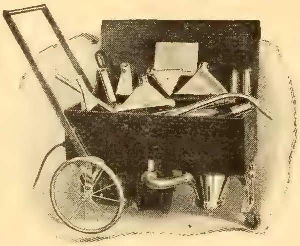

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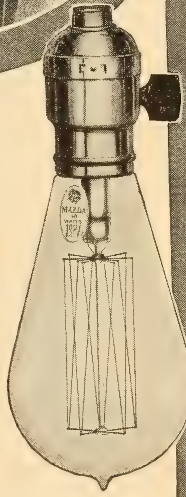

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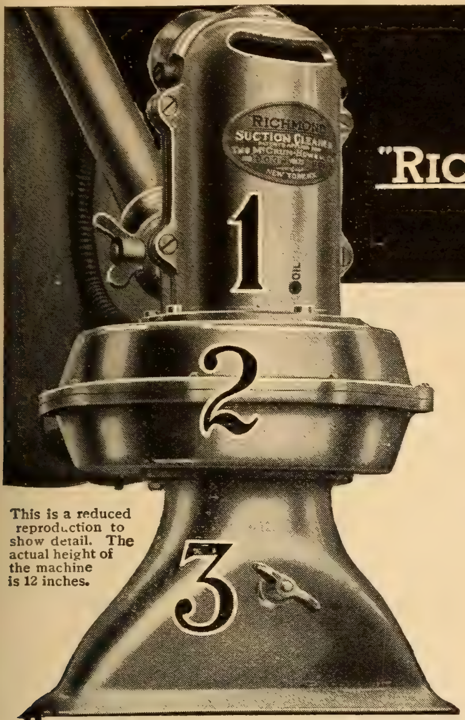

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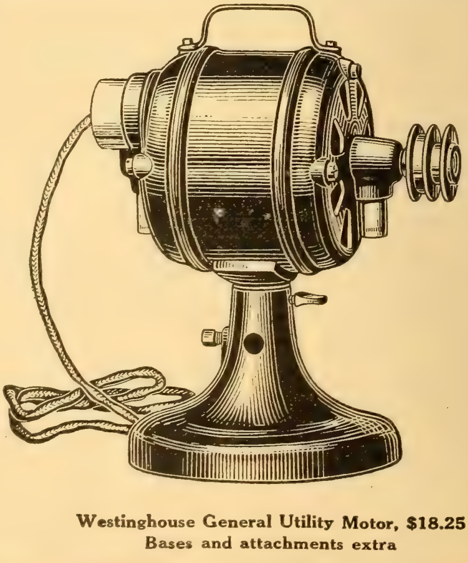

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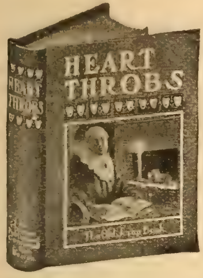

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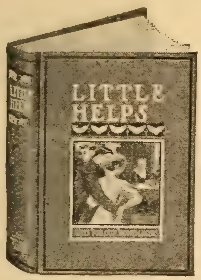

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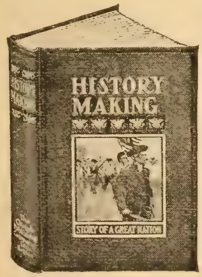

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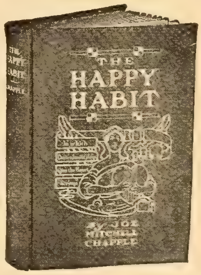

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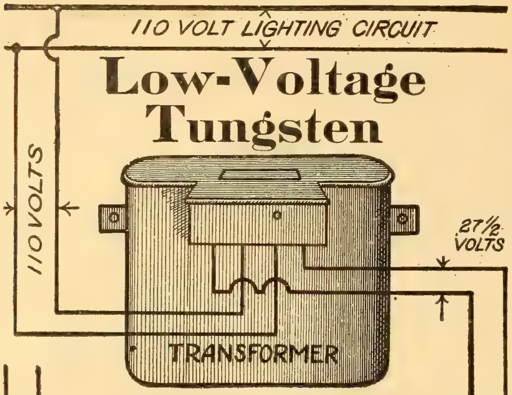

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¶ Send for our catalogue 600-P and tell us number and kind of lamp you are using.

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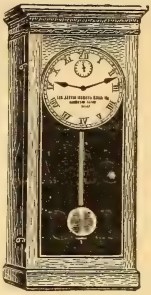

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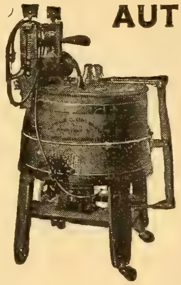

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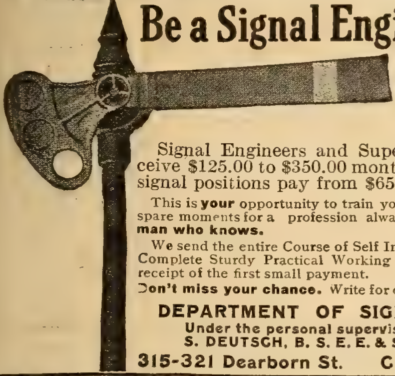

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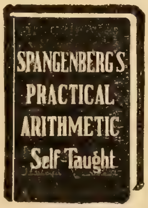

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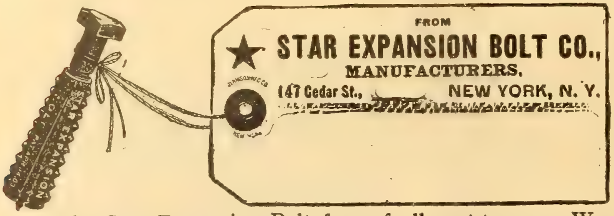

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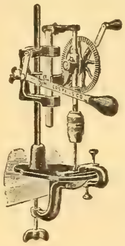

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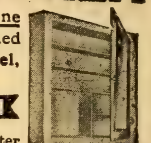

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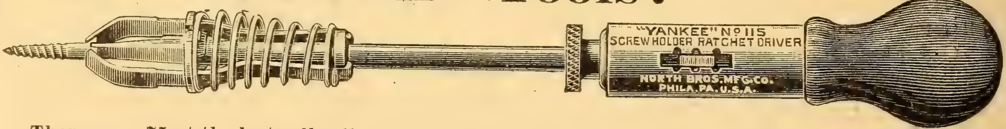
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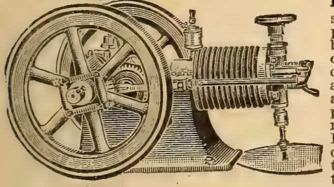

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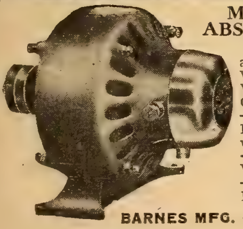

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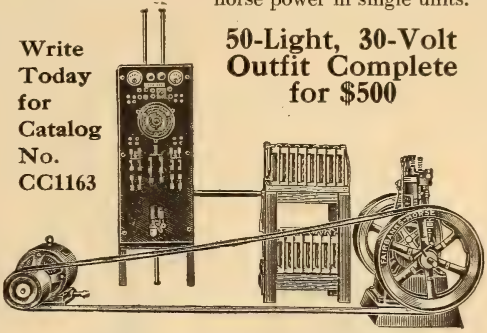

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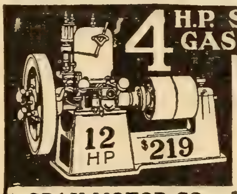

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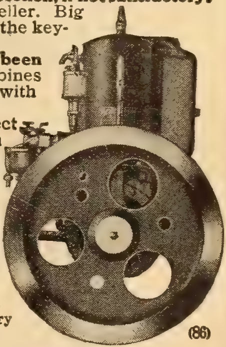

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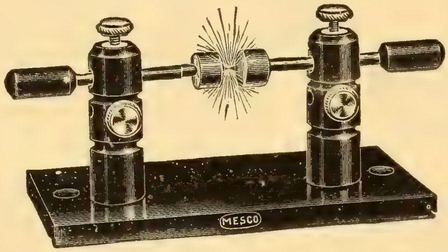

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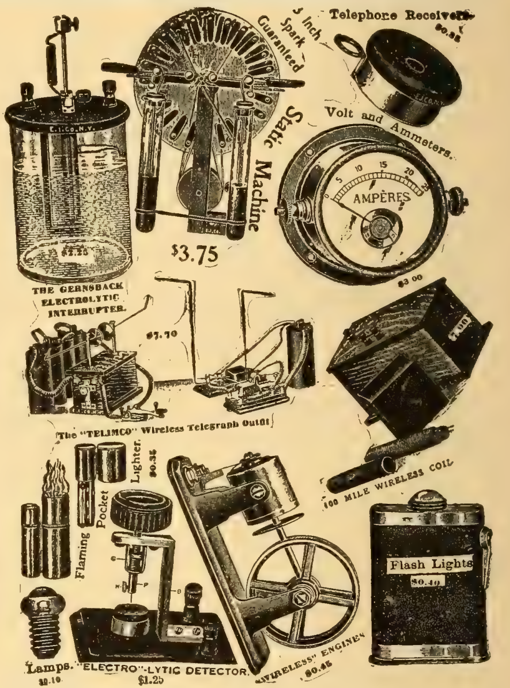

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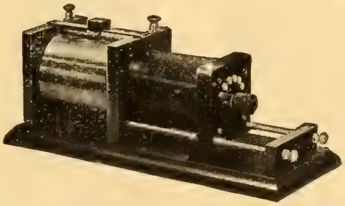

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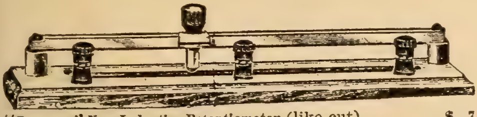

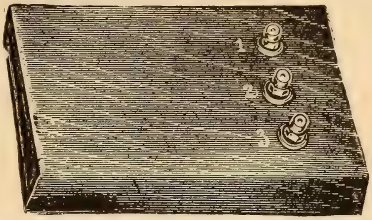

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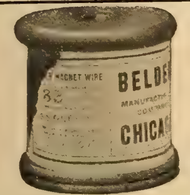
No. 36-Single-Cotton-Covered wire lb...$1.75

"Bwaenco" Fixed Condenser (like cut) 65c

Brooklyn Wireless Co., Inc., 766 Broadway, Brooklyn, N. Y.



Belden Magnet Wire

Our SILK and COTTON covered MAGNET WIRE is accurate to gauge with insulation of perfect uniformity and continuity and is put up one piece only per spool.

Beldenamel Magnet Wire is insulated with several layers of tough elastic enamel separately applied and baked on. It possesses the highest insulating strength and will not become brittle and flake off.

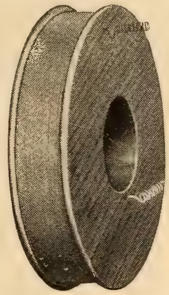
We quote the following net prices to readers of this paper and will ship postage or express prepaid on receipt of cash. **No orders filled amounting to less than $1.00.**

Prices are per pound.

Size	Single Cotton	Beldenamel	Single Silk	Double Cotton	Double Silk
16			.48		.61
17			.49		.62
18			.50		.64
19			.52		.65
20	.35	.48	.53	.38	.67
21	.36	.49	.54	.42	.69
22	.37	.51	.55	.44	.73
23	.39	.53	.58	.47	.77
24	.41	.56	.61	.50	.83
25	.44	.60	.66	.55	.89
26	.48	.66	.72	.60	.99
27	.52	.71	.78	.66	1.11
28	.55	.77	.84	.72	1.20
29	.59	.84	.92	.78	1.33
30	.65	.93	1.02	.85	1.54
31	.74	1.06	1.15	.92	1.85
32	.77	1.19	1.30	.98	2.04
33	.86	1.35	1.48	1.13	2.40
34	1.04	1.60	1.74	1.32	2.76
35	1.12	1.86	2.03	1.60	3.17
36	1.27	2.16	2.35	1.80	3.59
37	1.62	2.56	2.80	2.58	4.42
38	2.16	3.07	3.35	3.42	5.06
39	2.82	3.72	4.05	4.32	5.85
40	3.60	4.48	4.88	5.40	6.92

Belden Mfg. Co., 2306 S. Western Ave.
CHICAGO, ILL.

SECONDARY "UNITS"



Been having trouble winding your Secondary for your Induction Coil or Transformer? Why not put your worries on our shoulders? The winding is not a WORRY to us, as we have the equipment, and winding coils is a part of our BUSINESS.

Our Secondary "UNITS" are wood spool sections wound, parafined, etc., and all ready to connect up. You can buy a spool at a time or as many as you want, and they will cost you but little more than the wire alone,

Send 2-cent stamp for our large catalogue which tells all about it and many other things "WIRELESS" besides.

Dawson & Winger Electric Co
429 Dearborn Street: Chicago, Ill.

NEW WIRELESS WONDER

Aero-Field Receiving Outfit. Weight only 4 oz. Receives up to 75 miles. The Wireless Sensation of the year. Consists of 1000 Ohm, receiver and attachments all assembled on regular size leather insulated head band. Price $4.00 (not including light field aerial). A wonderful instrument at a wonderful price. Boy scouts and all requiring light outfits send 2c for description of the Aero and catalogue. **Etheric Electric Co.,** Salesrooms and Factories, 278 Lenox Ave., cor. 124th St., 71 Barclay St., New York, N. Y.

10 AMP.-HOUR STORAGE CELL

PRICE $1.00

The most durable and reliable battery made. Your Wireless Set will send signals from 25-30 per cent. farther when these Storage Cells are used in lieu of other forms of battery. We also **MANUFACTURE** a complete line of Wireless Telegraph and Telephone Apparatus, Dynamos, Motors, Rectifiers, Transformers, Gasoline Engines, Model Aeroplanes, etc.

Send 2c stamp for descriptive matter.

ADAMS-MORGAN CO.
"The Experimenter's Supply Co."
Box 72a Upper Montclair, N. J.

WIRELESS APPARATUS

Our Wireless Goods are the best on the market, and are guaranteed to *work*. Our instruments are made of the finest materials, and are sold at present at a price within the reach of every experimenter. Send 2c stamp for our large catalogue which contains a full list of Wireless Instruments, Novelties and Electrical Goods, and also a great deal of Wireless information for the Wireless experimenter.

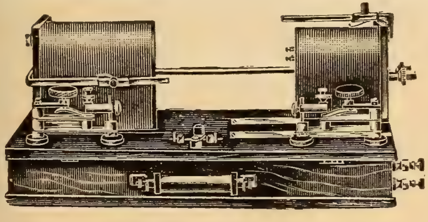
The I. W. T. Wireless Co., 726½ Broadway, Brooklyn, N. Y.

Beware of Imitators

Owing to the great success of my **Improved Navy Wireless Receivers** for long distance work, some concerns are misrepresenting them. The receivers I make have my name on them. **Look for it.**

Send for new catalog and testimonials.

C. BRANDES, 111 Broadway, New York
San Francisco Agent:
C. F. King, 163 Belvedere Street.



BIG 200 Page Electrical Catalog

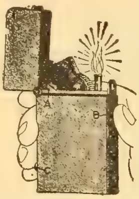
The Greatest Line of Wireless and Electrical Goods Extant

Send 4c stamp (to cover postage only) for this catalog, deducting same, if desired, from first order.

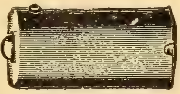
The Receiving Set shown in cut, is mounted in a mahogany cabinet, and costs but $40.00. Instruments unmounted cost considerably less. Set consists of two of our **Celebrated Ferron Detectors,** special wound **Receiving Transformer** with exclusive patented features. **Tubular Condenser** and our specially wound 1000 ohm Double Head Set. **Set cannot be duplicated elsewhere for less than twice the price.** Approximate range 1000 miles.

J. J. DUCK, 428 St. Clair Street, TOLEDO, OHIO

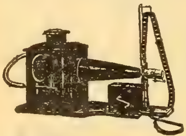
Wireless Supplies and Electrical Novelties
FOR HOLIDAY GIFTS



Combination pocket light and cigar lighter. The best metallic friction spark lighter on the market. Will last a lifetime. Press the button, the lid springs up, and the sparks from the "Ceric-Iron" pill ignite the wick. Unscrew valve and fill with 40 drops benzine, gasoline or alcohol which will last 8 days. Benzine preferred. Regular price $1.50.
Our price. By mail postpaid..........**95c**
Extra "Ceric-Iron" refill Pill..........**10c**



Nickel Tungsten Flashlight, with (new process) Merchlor Battery, and enameled Tungsten Bulb.
Price by mail postpaid..........**95c**
In silver finish..........**$1.35**
In gold finish.......... **1.50**
Extra Battery (Merchlor)..........**25c.**
Extra Tungsten Bulb (fiat)..........**35c.**

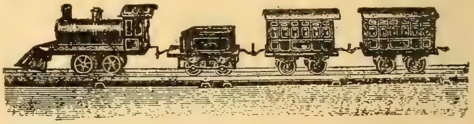


Acetylene Moving Picture Machine. Throws a 5x5 picture 20 feet. 500 candle power. Safer than kerosene oil. Regular price, $10.00.
Our price, with 5-ft. film.....**$4.35**

Electric Engine Outfit. Red Seal battery, engine and water bucket.
By Express..........**$ .95**
With extra piece of shafting and wind-mill added..........**1.35**

We carry a complete stock of Wireless Goods, Flash Lights and Batteries, Tungsten and Carbon Battery Lamps, Telegraph Outfits, Motors, Engines, Trains, Toys, and Pocket Cigar Lighters.

Complete Wireless Outfit. Will reeeive 50 miles, and send two miles. Consisting of Auto Coherer, Receiver, Fixed Condenser, Double Slide Tuning Coil, 1 inch spark Coil, Rheostat Regulator, Key, Spark Gap, and 1 pound aluminum wire. Will operate on from 4 to 6 dry cells, and can be tuned perfectly. Regular price $11.50.
Special, by express..........**$9.35**



No. 2 Complete Electric Train Outfit, consisting of Locomotive, Tender, 2 trailers, and set of third rail track (2 straight and 4 curved). Will operate on 1 or 2 dry cells.
Holiday price, complete, by express..........**$1.65**

No. 9. Larger Locomotive with headlight, larger trailers, and 4 sections straight and 4 sections curved track. Price complete.....**$3.90**
Extra sections (1 foot) third rail track..........**15**

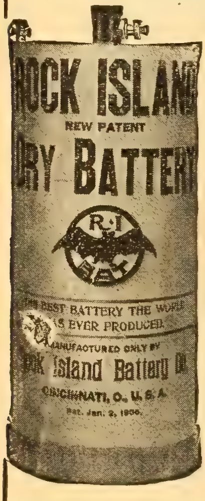
Send 4c stamp for our Wireless Booklet and General Catalog of Electrical Novelties.

PRICES: Wireless Booklet, Net; Large Catalog, 20 per cent Discount.

ANDERSON LIGHT & SPECIALTY CO.
Known as LA SALLE LIGHT STORE
70 La Salle Street (Opposite the New City Hall), CHICAGO

They Last Longer

R·I BAT



BECAUSE they are handmade, of **superior** materials, with greater carbon surface than used in ordinary tossed-together by machinery batteries,—

Rock Island DRY CELLS

have won **international** distinction as **dependable** batteries for **all** electrical purposes.

Price 25 cents

Battery Booklet N FREE. Write for it TODAY.

THE ROCK ISLAND BATTERY CO.
Winton Place Station,
CINCINNATI, OHIO

ENAMEL INSULATED FRENCH *Feval* PROCESS **MAGNET WIRE**

ENAMEL WIRE is supplanting silk and cotton covered because **The Insulation is better,** because **It requires less space,** because **It is cheaper.**

FEVAL WIRE has a dielectric strength in excess of 75 volts per .0001 inch of insulation. The evenly distributed enamel covering adheres tenaciously yet is resistant and elastic, never cracking. No change at 400° to 500° F. All sizes, Nos. 16 to 40.

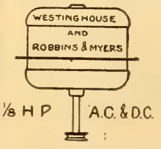
MANUFACTURERS: We have an attractive contract proposal to offer covering your requirements for 12 months.

INDIVIDUALS: We will furnish small quantities for spark coils and magnets.

FEVAL ENAMEL INSULATED WIRE CO.
129 N. Curtis Street CHICAGO

HALF PRICE—SMALL QUANTITY

SMALL MOTORS



Just right size for all household purposes or light mechanical work—Operate perfectly from any electric light socket—Absolutely dust proof — Operates either vertically or horizontally. First checks or postoffice orders for

$14.50 Get Them

State whether direct or alternating current, also voltage and cycles. Motors guaranteed in perfect running order. Address

THE W. H. HOOVER COMPANY
Dept. "M" New Berlin, O.

A Live Boy's Choice for Christmas

THORDARSON'S TOY TRANSFORMERS

Attach to any alternating current lamp socket and have a miniature Power Plant of your own. Operates any class of electrical toys, rings bells, lights small lamps and does any of the dozens of things you want to do. **Indestructible.** Besides the fun you get you learn the fundamental working principles of electricity—no more battery trouble. Show this to your father.

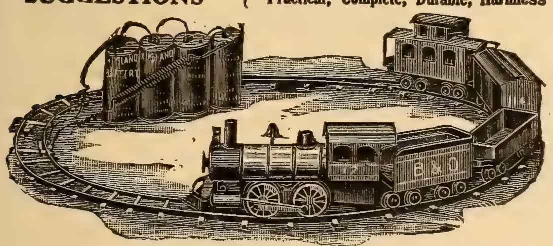
Write us for descriptive circular

Thordarson Electric Mfg. Company

220 So. Jefferson St., Chicago

ELECTRICAL TOYS FOR BOYS

SOME CHRISTMAS SUGGESTIONS { **SCIENTIFIC ELECTRICAL NOVELTIES**
Practical, Complete, Durable, Harmless



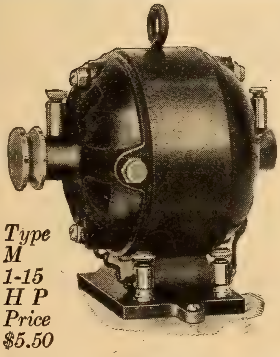
EVERY boy in the country can easily *own* a railroad. Costs little and pays big dividends in fun. Our Models of **Locomotives, Trains, Trolley Cars, Dynamos, Lamps, etc.** are practicable and durable inventions. Equipped with dry batteries, no acids or liquids used, perfectly safe and harmless. Electrical toys instruct as well as amuse.

Catalog B, fully illustrated, quoting low prices—SENT FREE.

THE CARLISLE & FINCH CO.

264 E. Clifton Ave., Cincinnati, Ohio

Largest Manufacturers Electrical Novelties in the World.



Type M 1-15 H P Price $5.50

New Toy Motors For Boys

WITH ALL THE LATEST IMPROVEMENTS

WOUND FOR 110 VOLTS BOTH ALTERNATING AND DIRECT CURRENT

No more trouble or expense with batteries. Simply use an attachment cord connected to any lamp socket. The best motors made for operating mechanical toys, models, advertising devices, 8-inch fan blades, etc. No boy's experimental laboratory complete without one of these motors. *Exact reproductions of large commercial motors* beautifully finished in black enamel; brass parts polished.

TYPE C.	1-30	H. P.	WEIGHS	2 1-4	LBS.	$3.50
" D.	1-25	"	"	3	"	4.50
" M.	1-15	"	"	4	"	5.50

Type C. and D have field ring made in one piece. Type M. has laminated field and armature built of the best grade of electric sheet steel, 3-16-inch self-adjusting carbon brushes, mica insulated commutator, long bronze bearings, brass oilers, large brass pulley and brass terminals. This is the most efficient small motor on the market. Positively will not run hot.

Special for the Electrical Student—These motors complete, in parts, ready to assemble, with blue prints: Type C. $2. Type D. $2.50, Type M. $4.00 Special offer for a limited time only. A chance for the ambitious boy to perform numerous experiments to which he can point with pride and say: "I did it."

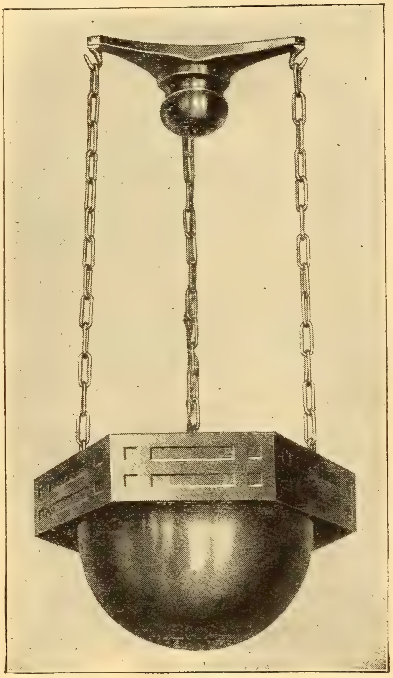
Send Express or P. O. Money Order

JOSEPH WEIDENHOFF, Manufacturer of Electrical Specialties, 1215 SOUTH ASHLAND AVENUE, CHICAGO

At Last

it is possible to secure comfortable, even illumination throughout a room without a brilliant light in range of vision.

¶The **Eye Comfort System** of Indirect Illumination is the notable success in the lighting field.



If you are interested in the rational, beautiful illumination of any

- ¶ **Church,**
- ¶ **Residence,**
- ¶ **Office,**
- ¶ **Restaurant,**
- ¶ **Hotel,**
- ¶ **Store or**
- ¶ **Club**

write us for full information and photographs of installations in similar places that are attracting widespread, favorable attention.

WRITE TODAY

National X-Ray Reflector Co.
257 Jackson Boulevard
CHICAGO, ILL.

An Electric Cook Stove

That is Practical and Reasonable

Two kinds of stoves—Electric and Fireless—for the price of one.

Ask About It

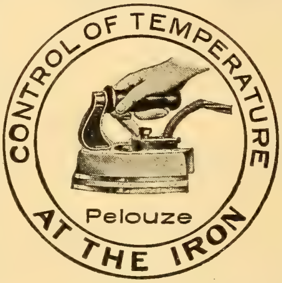
The Comet Electric Stove is designed to save fuel. It does a day's cooking at the cost of burning an ordinary electric light less than one hour.

Reasonable to buy—convenient to use—economical for the Home, Camp, Motor Boat, or Automobile. You don't have to depend on electricity alone—it's a fireless cooker as well.

Ask us more about it now—today. Special prices to Central Stations and Dealers.

COMET ELECTRIC STOVE CO.
280-284 Eighteenth Street **DETROIT, MICH.**

Pelouze Electric Iron



Consumes less current than other irons

The only Electric Iron in which the current and temperature can be controlled at the iron.

The Iron that Guarantees Satisfaction.

No Fire No Dirt No Odor

Every Iron Guaranteed

4 lb.	6½ lb.	9 lb.	20 lb.
$5.00	$5.00	$7.00	$12.50

For Sale by Leading Dealers

PELOUZE ELECTRIC HEATER CO.
232 East Ohio St., CHICAGO, ILL.

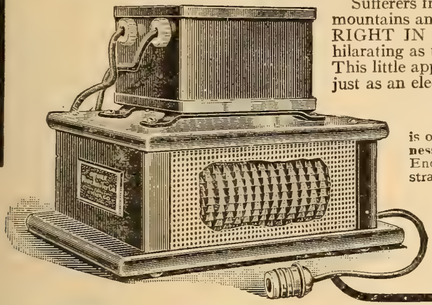
The Thor Electric Home Laundry Machine

This cut shows the Thor washing and wringing clothes at the same time.

Write for catalog.

HurleyMachineCo.
29 S. Clinton St.
CHICAGO
1010 Flat Iron Bldg.
NEW YORK

Let Electricity Make Pure Air for You



Sufferers from many ailments travel thousands of miles to breathe the OZONE of the mountains and pine forests. Yet a recent scientific invention enables everyone to have—RIGHT IN THEIR OWN BEDROOM—air constantly as pure, refreshing and exhilarating as the purest oxygen-filled atmosphere of the piny woods and mountain peaks. This little apparatus is operated by electricity and "ozonizes" the air of the closest room just as an electric storm purifies the out-door air. The

OZONE PURE AIRIFIER

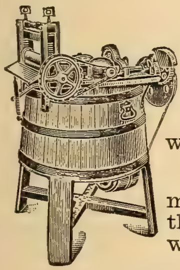
is of greatest benefit in the treatment of **Asthma, Hay Fever, Catarrh, Insomnia, Nervousness, Pneumonia, Typhoid and Scarlet Fevers, Diphtheria, Bronchitis, Tuberculosis, etc.** Endorsed by highest medical and scientific authoritiesa thoroughly tested and demonstrated success.

Central Station, Electric Jobber and Dealer, this is the latest Electrical Appliance on the market. Write now for illustrated catalogue, price list and descriptive matter and plan of placing for liberal trial.

We want distribution throughout the United States in Every Place Where Electrical Appliances are Sold.

OZONE PURE AIRIFIER COMPANY
307-314 Rand McNally Bldg. CHICAGO, ILL.

Back Gears Save Power Enough to Pay For It



The back gear drive of the Elmo Power Washer enables it to do a big washing with the same amount of power that ordinarly does a small washing.

It is like the muscular man who does twice or three times the work of a weak man.

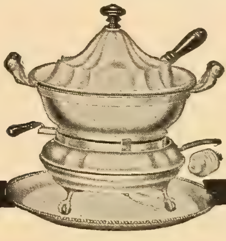
The Elmo

has also a positive action wringer, an easy-opening lid, a protected motor. It is noiseless, strongly built, has cypress tub good for fifty years use, and will do a week's wash at an average cost of 1c. for power.

Write for booklet that teils the whole story of Elmo supremacy.

Grinnell Washing Machine Co.
Grinnell, Ia,

Canadian Trade Supplied by the Gem Motor Co.,
419 Portage Ave., Winnipeg, Man.



Holiday Suggestions

Simplex Electric Chafing Dishes, Coffee Percolators and Dining-Room Sets, make unique and acceptable Holiday and Wedding gifts. Other seasonable suggestions are Water Cups, Toasters, Travellers' Stoves, Heating Pads, Baby Milk Warmers and Household Irons—packed in Holly Boxes. At your lighting company or dealers. Descriptive folders "P" on request.

Simplex Electric Heating Co.
CAMBRIDGE, MASS.
CHICAGO **SAN FRANCISCO**
Monadnock Block **612 Howard St.**

BE CLEAN!!

YOU WANT

The "BEE" SUCTION CLEANER

BECAUSE

It costs only $65.00 with complete equipment
It weighs only 20 lbs. No jar or vibration
It equals the highest price machines in efficiency
Best work with the least effort
New and exclusive features

BIRTMAN ELECTRIC CO., CHICAGO, U.S.A.

CUTLER-HAMMER

Electric Heating Devices

are convenient, reliable and economical to operate.

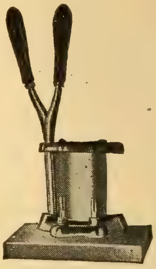
Electric Water Heater
4 Quart Size
Steaming Hot Water in 45 seconds

We make three sizes of Household Irons and a small three pound Sleeve Iron with detachable handle, convenient for the traveler to carry and well suited for ironing fancy doilies, laces, etc. The value of an Electric Iron to a woman cannot be over-estimated.

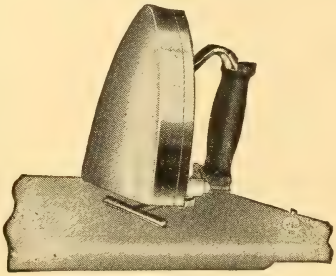
Portable Water Heaters are useful in the drug store, restaurant, bar, etc., and in the home. They provide clean hot water for medicinal purposes and for making all kinds of hot drinks.

The Disc Stove, Curling Iron Heater and Shaving Mug have several exclusive features

Send for our 32-page booklet which contains descriptions and illustrations of our entire line.



Curling Iron Heater
Automatic
Current Control



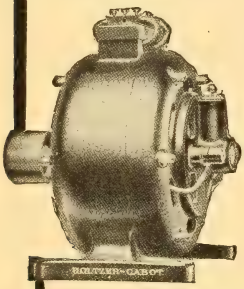
Household Iron
Made in 5, 6 and 7 pound sizes
Requires no Stand

The Cutler-Hammer Mfg. Co.

Milwaukee, Wisconsin

NEW YORK: Hudson Terminal (50 Church Street) **CHICAGO:** Monadnock Block
PITTSBURG: Farmers' Bank Building **BOSTON:** 176 Federal Street **PHILADELPHIA:** 1207 Commonwealth Trust Building **CLEVELAND:** 1108 Schofield Building
PACIFIC COAST AGENTS: Otis & Squires, 155 New Montgomery St., SAN FRANCISCO

Motors for all Purposes—1-20 to 1-2 H. P. Single Phase



Holtzer-Cabot Motors are made for all kinds of purposes—washing machines, vacuum cleaners, adding machines, ozone machines. Any mechanical appliance requiring motors from 1-20 to 1-2 H. P. are absolutely perfect when carrying

Holtzer-Cabot Motors

We make a specialty of single phase alternating current motors and build them from manufacturers' designs and on specifications.

Absolutely perfect in workmanship and electrical design.

We will send you our catalogue 330-D immediately for the asking.

THE HOLTZER-CABOT ELECTRIC CO.

621 Albany St., Boston, Mass. **6161-65 S. State St., Chicago, Ill.**

TESTED APPARATUS Means the Elimination of Faults in Your Product.

Electrical and photometrical tests of every description.
Checking electrical instruments of all kinds and classes.
Inspecting and testing new electrical machinery, apparatus and material at factories and after installation.
Tests on any electrical machinery and apparatus made anywhere.
Arc and incandescent lamp tests, either electric, gas, acetylene or oil.
Illumination tests made anywhere.
Secondary standards of candle-power furnished.
Facilities furnished to experimenters and investigators.

We have recently added to the above, coal testing, and are now prepared to make proximate analyses and calorific determinations on samples of coal, promptly and accurately.

ELECTRICAL TESTING LABORATORIES

80th Street and East End Avenue **NEW YORK, N. Y.**

We Saved Him $800 On This Bungalow!

Write for Gordon-Van Tine Co.'s Great FREE Home-Builders' Catalog and the Plan Book

The money we saved Dr. Whitehurst on his beautiful bungalow is an example of what we are doing for home-builders throughout the entire country. Over half a million people are buying their materials at **bargain prices**, direct from our great Millwork and Lumber Plant. We carry a tremendous stock of building material—everything needed to build complete and beautiful homes of the most modern types, even to mantels and hardware. We guarantee quick shipment, no matter how large the order. Quality, safe delivery and satisfaction guaranteed or money refunded.

Here's His Letter

Peniel, Texas, May 7, 1910.

Gordon-Van Tine Co., Davenport, Iowa.

Gents: Enclosed are photos of our new house, in which we used your millwork, including White Pine Siding, Maple Flooring and Bishopric Mastic Wall Board. It is almost a Gordon-Van Tine house.

I have the swellest bungalow I think I ever saw now and saved about $800.00 in the building of it.

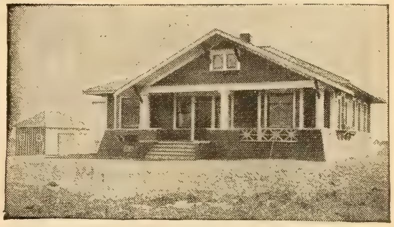
I received your check for $25.70 some time back, covering an overcharge in freight.

Please accept my thanks for your honest treatment.

These hardwood veneered doors, thick maple floors and Queen Anne windows are the talk of the town.

Respectfully,

D. Whitehurst Md.



Front View of Dr. Whitehurst's Bungalow

Isn't This Good Evidence of Dr. Whitehurst's Satisfaction?

Interior View of Dining Room

We Protect Our Customers' Interests in Every Possible Way

Side View of Bungalow

Further Evidence of Intense Satisfaction

Have You Written for Our Latest HOME-BUILDERS' CATALOG?

Solely through this wonderful Catalog of 5,000 Bargains in highest grade Millwork and Lumber we have built up a patronage extending from ocean to ocean. Everything offered at **dealers' prices.** Every item we sell is guaranteed up to official grades of the Sash & Door Manufacturers' Associations.

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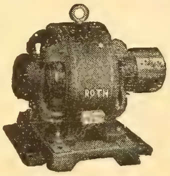

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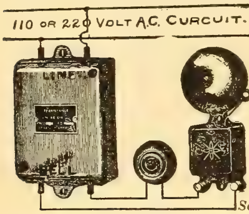

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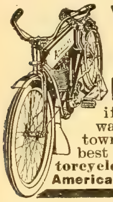

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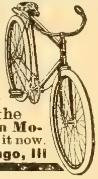

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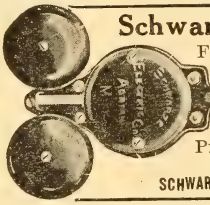

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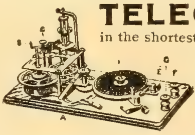

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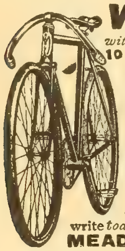

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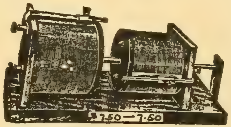

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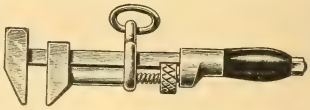
Special  Offer!

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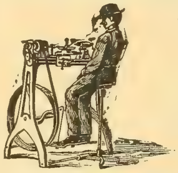

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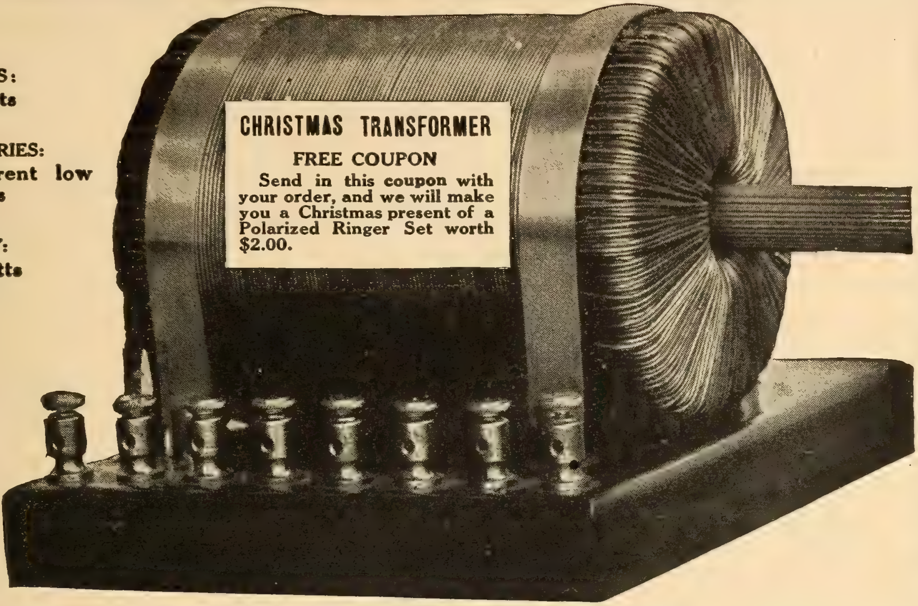

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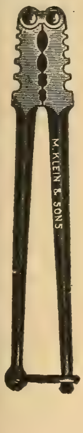

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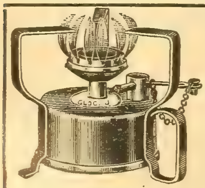

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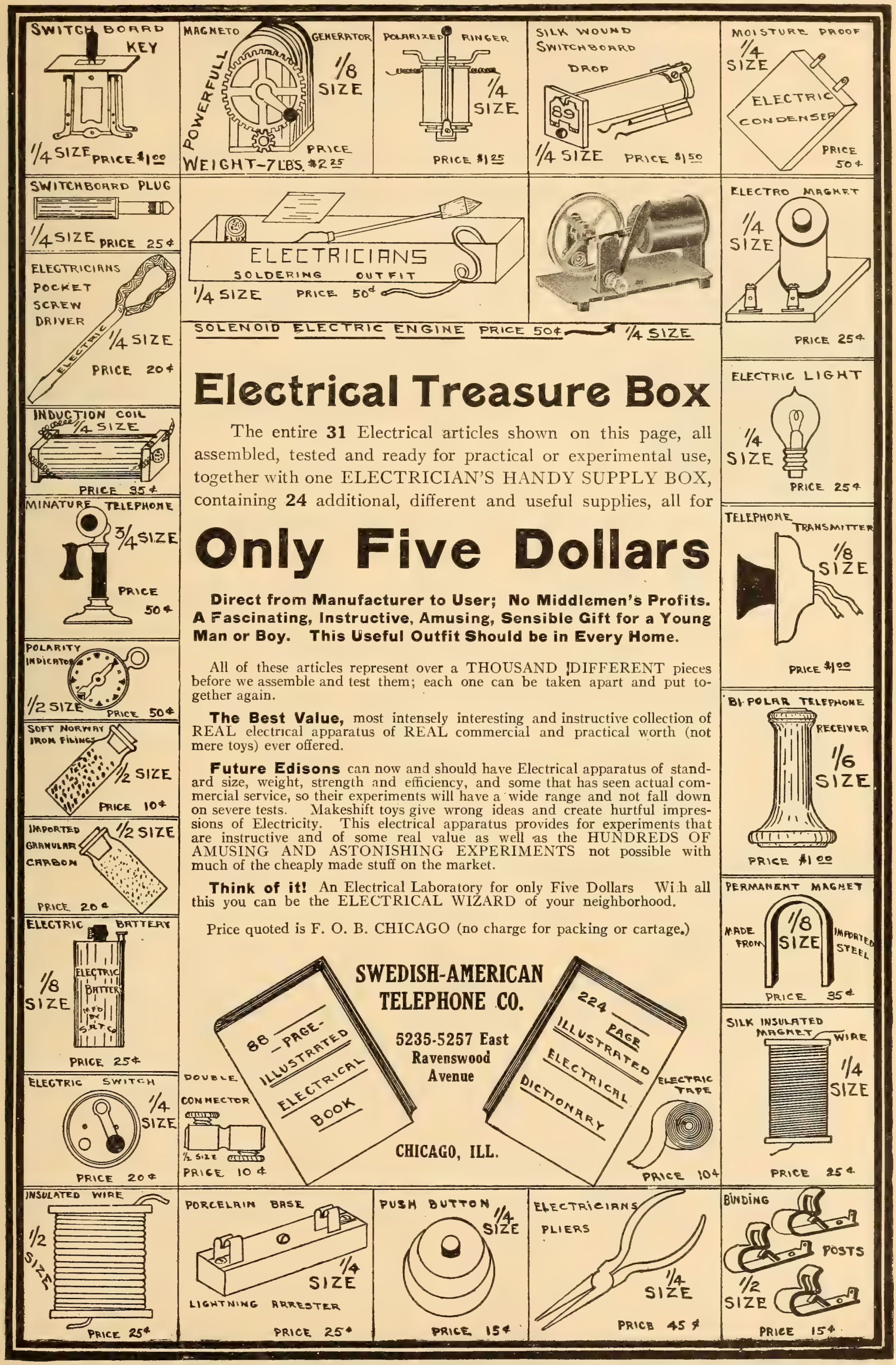

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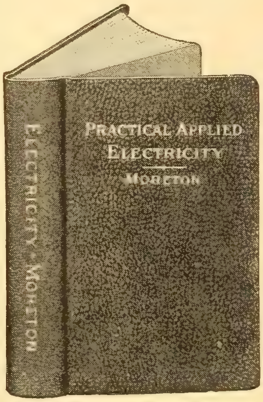

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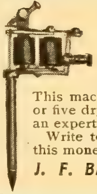

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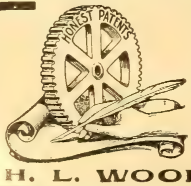

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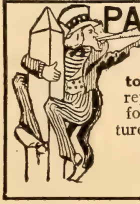

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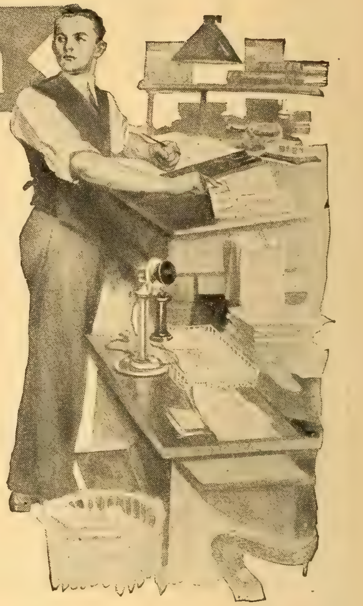

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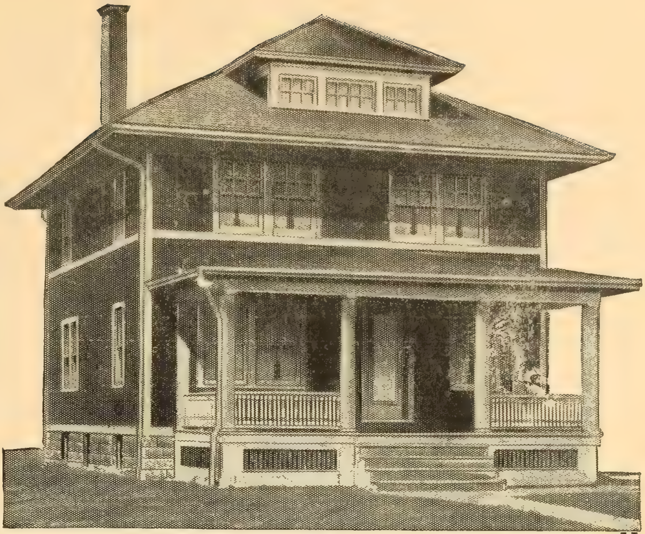

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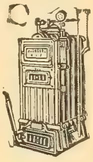

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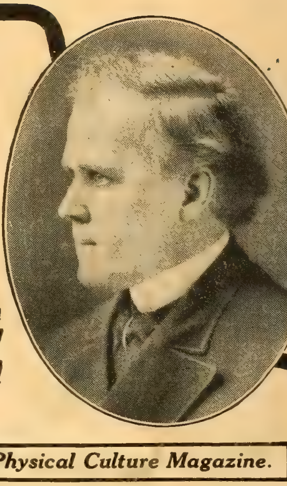

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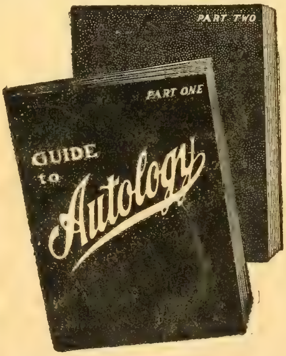

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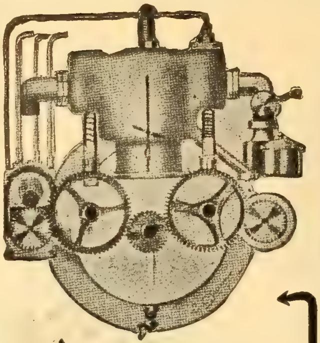

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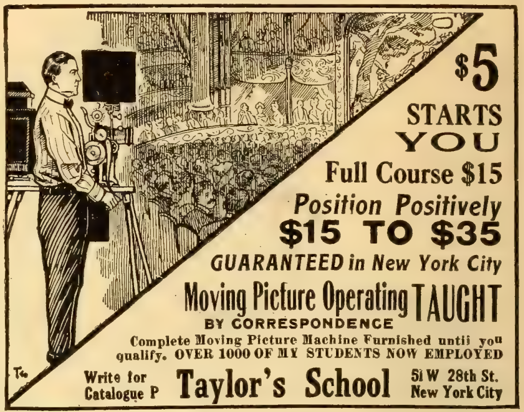

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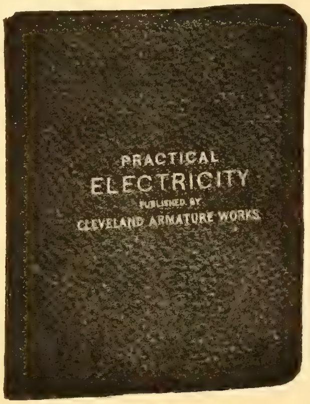

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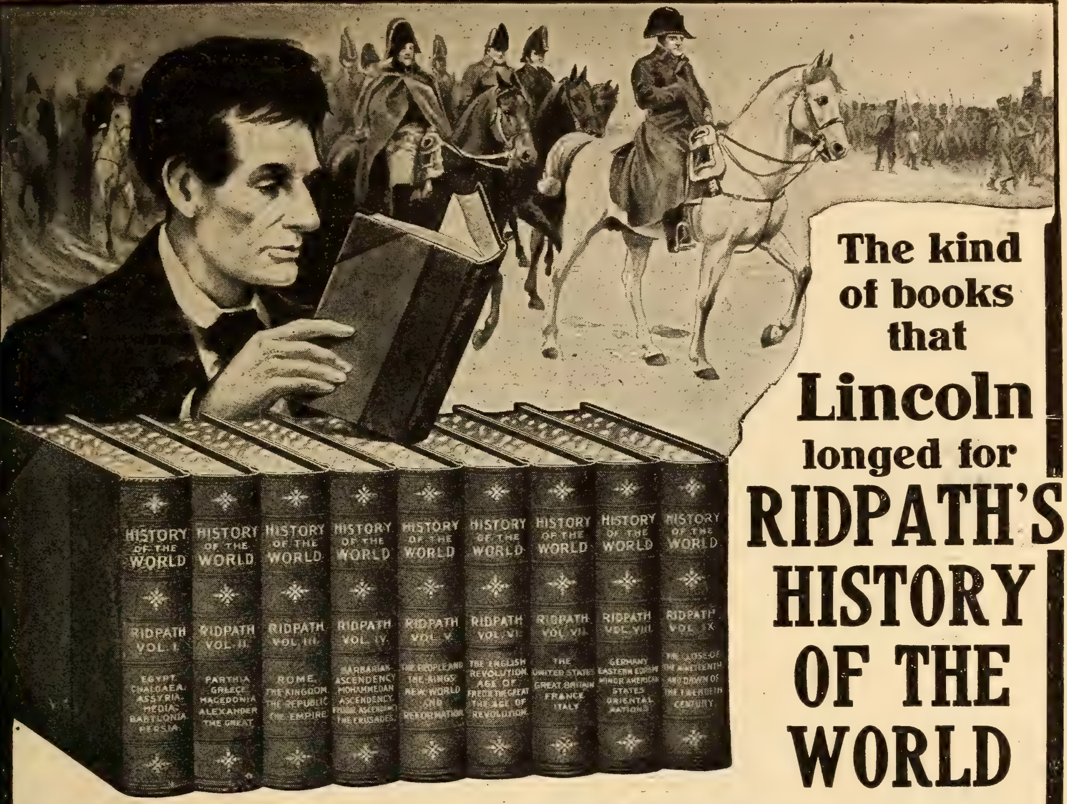
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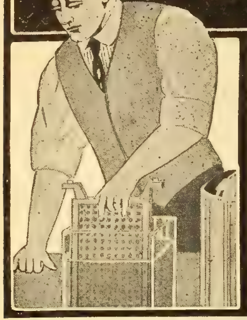

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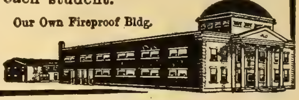

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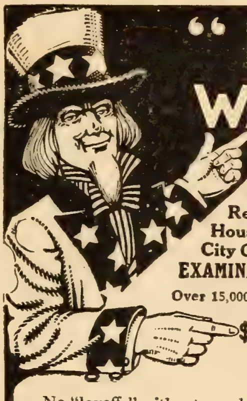

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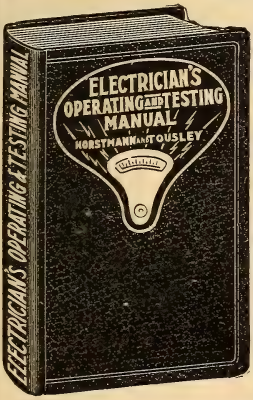
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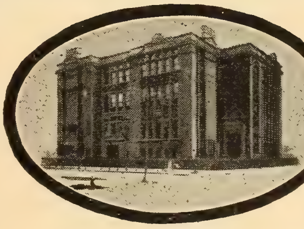

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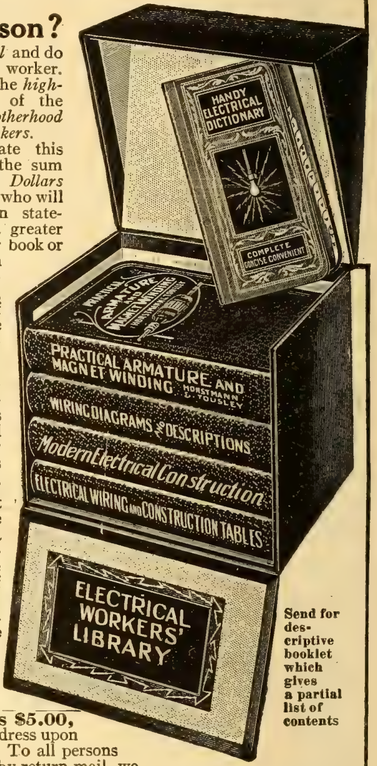
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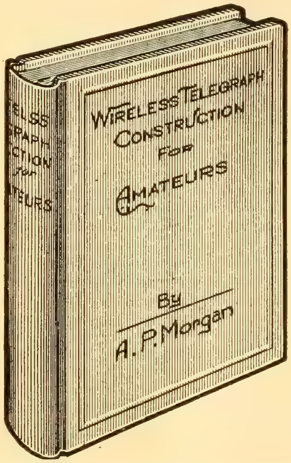

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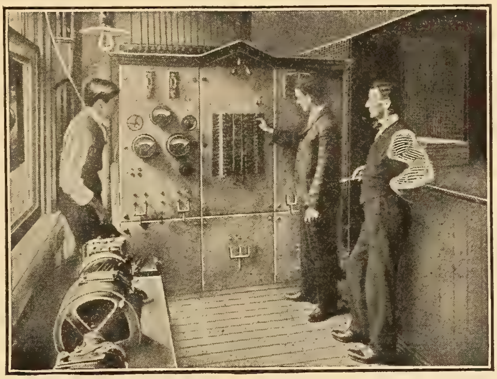
What Electricity Offers as a Life Work

By EDMUND SEARLES

The question of life-work is probably the most important which has to be solved. If the right kind of work is chosen and a thorough training secured in that line a capital is created which can never be taken away and which will yield large dividends both in money and satisfaction. Statistics compiled in California show the labor value of the people living in that state to be greater than the value of all other property in the state.

In these days of fierce competition and changing conditions which make the average work simply an employment by a large trust, a person is particularly fortunate who can secure a complete knowledge of a line of work which will make him independent of combinations as well as to earn a satisfactory income. Electricity offers the greatest opportunity to do this.



MOTOR-GENERATOR AND SWITCHBOARD IN TELEPHONE AND TELEGRAPH DEPARTMENT

It is said that electricity is still in its infancy in spite of the tremendous development that has already taken place. While electricity is used in a great many ways, yet the opportunity for extending the use of current is almost boundless. In the use for lighting purposes it can still be developed so as to cover every community where a few hundred people can be reached. For use in factories for power and light, electricity can be extended so that before many years it is probable that almost all machinery will be driven by electric current. Its use by the telephone and telegraph systems is steadily being extended. The general development for business use looks larger than the prospect in any other line.

In addition to the many present uses, electricity will be developed to include many others. For instance, it will not be long before electric heat will be used in many homes. Electricity will soon be the motive power on the majority of the transportation lines, and in many ways not now known electricity will be found useful.

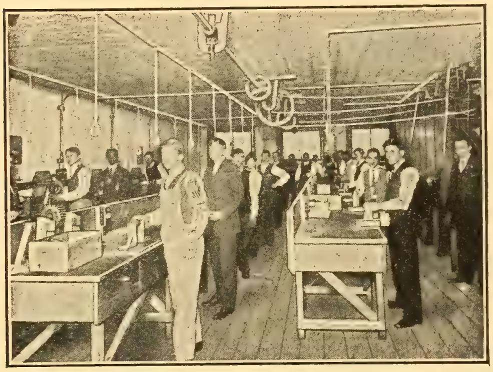
STUDENTS INSTALLING METERS, INCANDESCENT AND ARC LIGHTS

One of the greatest tributes to the commercial value of electricity was given when the new Pennsylvania service was opened into the heart of New York City. This was made possible by electricity. Electric engines are now attached to Pennsylvania trains at Harrison, N. J., twelve miles from New York City, which draw the trains through the tunnels under the Hudson River into the wonderful new station at 33rd Street, New York. Thousands of men have been given employment in connection with the electrical work on this new system.

An Electrical show was recently held in New York City, at which were exhibited many new electrical devices to be used in the home, in the factory and for public utilities. A visit to this Show demonstrated the progress made by the manufacturers of electrical devices and indicated that in a brief time most of the results now obtained by the use of coal and gas would be secured by electric current.

Electricity is taught in theory in many of the educational institutions of the country. In some few educational institutions a limited amount of practice is added to the theoretical instructions.

A review of the many institutions teaching electricity shows one institution which stands out pre-eminently for the complete manner in which both the theory and practice of electricity is taught. This is the New York Electrical School, located in the heart of New York City and occupying a building especially fitted for teaching electricity.



STUDENTS PERFORMING PRACTICAL WORK IN ARMATURE WINDING AND PATTERN MAKING

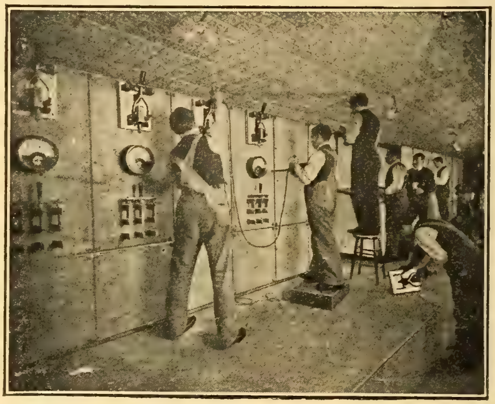
The student before enrolling in the New York Electrical School is taken through the school and shown the method by which electricity is taught. He is told of the theoretical instruction and sees for himself the students engaged in the actual work of carrying out the practice. He is given an opportunity to examine all departments of the school and to be sure that he will receive a thorough training before he is allowed to enroll as a student.

Upon entering the New York Electrical School the student is given a brief outline of the theory of electrical work. The lecturer assumes that the student has no knowledge of electricity and in the most easily understood language tells the electrical story. Many points are illustrated by picture and by the use of the blackboard, so as to bring out strongly each detail.

The wonderful electrical story is spread out for him and he grasps the fundamental points necessary for him to understand before he enters upon the practical work. The instructors are Electrical Engineers and practical electricians, and have been carefully chosen for their ability to explain to the uninformed student the vital points about electricity, without asking him to go through any tedious course of study.

After the first day, the student dons working clothes and begins actual practice. He is expected to apply the theory which is given to him in all of its details. In order that the theory may be kept before him, lectures are interspersed with the practical work, thus keeping alive the essential of the theory while at the same time applying them in practice.

The student does each part of electrical work. For instance, he learns the construction of a small battery and to connect it to a wire with a bell at one end and a push-button at the other so as to make the bell ring. From this small beginning he is carried along until he is proficient in his work. Towards the close of the course the student is assigned work to do which comes under the "trouble" head. That is, he is told to do a certain piece of electrical work with an instrument that is purposely put out of order and no student is graduated from the School until he can detect and remedy the trouble, no matter where it is located.



GENERAL VIEW OF MAIN SWITCH BOARD SHOWING STUDENTS EQUIPPING BOARD FOR HANDLING ALTERNATING AND DIRECT CURRENT

No time limit is placed upon the work of a student. After entering the New York Electrical School, he is advanced as rapidly as he is able to acquire the necessary knowledge. Some students are able to graduate in record time while others, being slower to grasp the information, take a longer period. But no student is expected to leave the School until his course is completed, irrespective of the time it takes.

Classes are held in both daytime and evenings. If the student is able to come in the daytime he may devote as much time as he likes to his work. But, if he is employed during the daytime he may take the evening course which is identical with the day course.

Some interesting developments have arisen from the work of students. For instance, a student recently came from England to take the course. He is the son of a multimillionaire. His father expects him to take charge of a large business in England. As part of his preliminary training he took the course in the New York Electrical School, so that he would be fully prepared to meet every emergency in his immense factories along electrical lines.

On the other hand, most of the students who enter the School expect to make electricity their life-work and to engage in the various recognized lines. Some continue as journeymen workers after graduation. A considerable number of the students put in several years in working at the electrical trade and then develop into the various higher branches of the electrical business. Some of them become electrical contractors or open stores for the sale and installation of electrical devices for the home. Still others find their training has fitted them to enter large business concerns as electrical advisors and many patents have been taken out by graduates of this school.

A number of students have enrolled for the purpose of learning the fundamentals of electricity in order to apply them to the every-day use of electrical current in the household. If a bell is out of order, they want to repair it themselves rather than to send for an electrician; if any trouble develops with the electric stove or electric lights they want to be in a position to handle it themselves. In view of the importance that electricity is assuming in the household the taking of a course for such a purpose is valuable and proves to be very economical.

Looking over the men who have started as electricians, we find that the growth of electricity has opened many positions which pay large salaries. The electrician working at his trade makes, according to United States statistics, a larger average wage than journeymen workers in other industrial lines. Electricians who have proven themselves proficient have found for themselves splendid positions with the Public Service corporations and large companies that want trained men of quality to take charge of their electrical departments.

To the man with an electrical training who is also a good business man the opportunities in electrical work are practically unlimited. The extension of electricity into the country generally, is going on rapidly and a knowledge of electricity backed by good business qualifications, enable a man to grasp these opportunities.

STUDENTS ENGAGED IN OPERATING A. C. AND D. C. SWITCHBOARD INSTALLATION

The New York Electrical School has prepared some interesting booklets telling of the possibilities of the electrical business, and giving details of the course of instruction offered, and will be pleased to send these booklets to anyone, on request. The young man just about to decide on his life-work, the man with a good business education who would like to enter the electrical business, and the man who wants to apply a knowledge of electricity to his every-day home-life, should write for copies of this literature.

Opportunity knocks but few times. There are thousands of men who regret their failure to grasp their opportunity. Many of these look back upon their wasted youth when they failed to learn some practical line of work. Perhaps this is your opportunity. Write for this literature.

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POPULAR ELECTRICITY
IN PLAIN ENGLISH

HENRY WALTER YOUNG, Editor

Vol. III February, 1911 No. 10

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MT. NIESEN, AS SEEN FROM THE LAKE OF THUN

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Popular Electricity
In Plain English

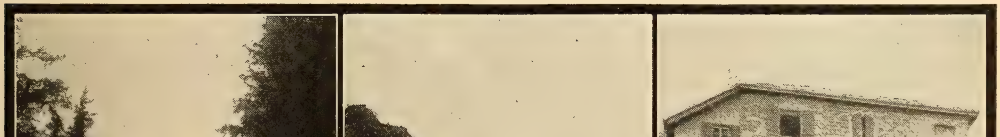
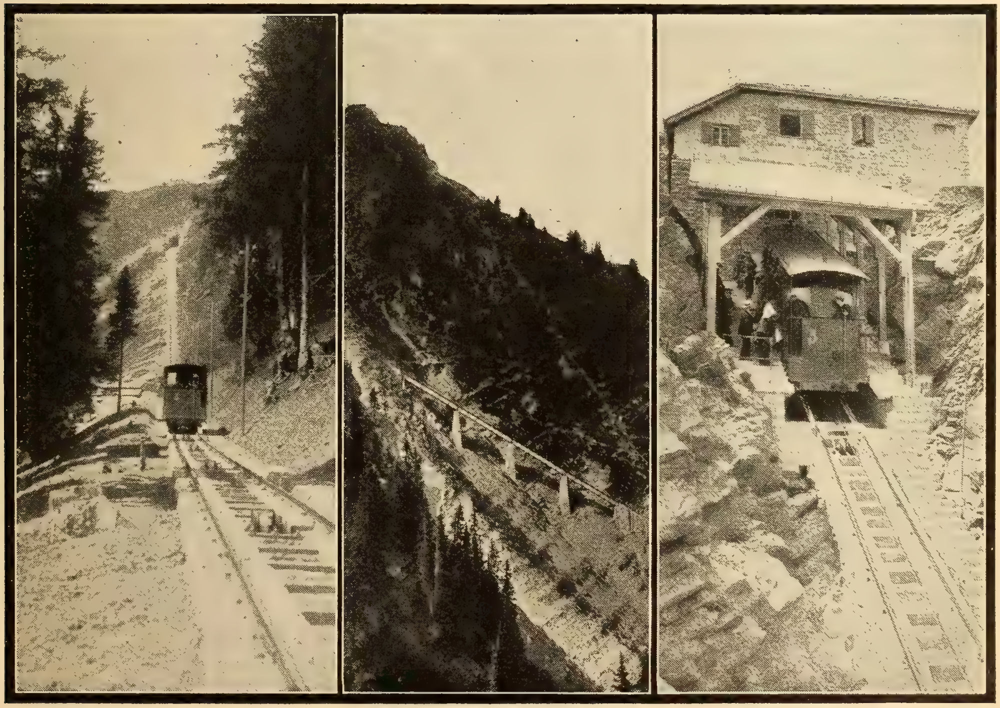
VOL. III FEBRUARY 1911 No. 10

A New Alpine Railway

By DR. ALFRED GRADENWITZ

The latest addition to the network of mountain railways traversing the various cantons of Switzerland is the electrical cable-way up Mt. Niesen, the imposing peak, which by the regularity of its profile, favorably impresses all tourists visiting the Bernese Oberland. The panorama embraced from this summit—as the extreme link in a mountain chain encompassing the left bank of the Lake of Thun—is of surpassing beauty and comprises the whole of the Bernese as well as some peaks of the Valasian Alps, encircling to the north the shining expanse of the lake with the many villages that dot its banks. The valleys of the north lead up to the High Alps, and the lowlands, in a western direction, stretch as far as the blue ribbon of the Jura River.

The very difficult ascent of Mt. Niesen is now made extremely easy by the cable-way

BEGINNING THE ASCENT OF MT. NIESEN

SCHLICTENWALD VIADUCT, WELL UP MT. NIESEN

THE TERMINAL STATION

above referred to, the starting point of which is situated at Mülenen-on-the-Kander, 2,300 feet above sea level, in the immediate neighborhood of the electric section of the Bernese Alpine Railway. It is reached in ten minutes from Spiez Station, the crossing point of the Berne-Thun, Montreux-Zweisimmen, and Interlaken lines and stopping place of the boats plying the Lake of Thun.

On account of technical reasons and in order to make the traffic more lively, the electric cable-way, 2¼ miles in length, was divided into two sections. The lower section leads in 30 minutes through shady pine woods to the intermediary station of Schwandegg (at 5,500 feet above sea level) whence an incomparable view is enjoyed on the lake and the surrounding valleys. After a journey full of variety of another 20 minutes there is reached the terminal station Niesen-Kulm, distant only two minutes from the summit of the mountain.

The ascent of this line is so steep that of course the ordinary kind of electric railway would be of no avail, so it is necessary to draw the cars up the incline by means of steel cables 1.4 inches in diameter. The cable is operated by immense drums which in turn receive their power from motors of 85 and 65 horsepower, respectively. Each car seats 40 people and its equipment includes hand and automatic brakes as well as telephones and alarms connecting with the power station.

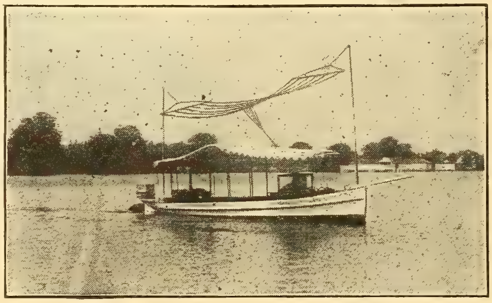
The road bed comprises a sort of masonry dam having on its right a stairway of 10,572 steps for anyone who has lung and heart power sufficient to make the long climb. There are seven important viaducts and two tunnels in the line.

Controlling Boats by Wireless

By ALBERT SCHEIBLE

Any craft that flies into the face of the enemy's fire must expect to go down with its crew. The only way to reduce the loss of life in such a move would consist in steering the vessel from a distance. This has long been one of the favorite dreams of naval experts and its coming true is foreshadowed by tests which the German firm of Beck, Wirth and Knauss have made on a lagoon at Nuremberg, known as the Dutzend Teich.

There, on a recent fine afternoon, a little cutter without a single man aboard was drifting aimlessly on the water when suddenly swinging to port, the crewless motorboat started its propellor and headed for the opposite shore. Tacking back and forth, sounding its gong as a warning signal when approaching other boats and even firing shots, the "Prince Ludwig" executed a series of maneuvres that not only surprised but dumbfounded all spectators. The mesh of wires high above its canopy implied a wireless equipment, but those watching it looked in vain for an operator on board the vessel. Then the more shrewd among them turned to the lighthouse tower with the long antennae that marked it as a wireless station. There, with one hand holding a spyglass and the other manipulating some levers or handles, stood an officer whose every move brought a response from the boat. Was he only experimenting? Or did he fancy that the approaching boats were an enemy's fleet? See! The motorboat heads for them; it puffs out a shot that might mean the firing of a torpedo if the battle were on a larger scale; it bumps into a buoy that might discharge submerged mines several minutes after the boat has beaten a hasty retreat, or just in time to damage the enemy's fleet; it swings close enough to the opposite shore to fire a bomb into the hostile camp—all in obedience to the wireless operator. The vessel itself might be dangerously exposed at all times,


MOTOR BOAT CONTROLLED BY WIRELESS

but even if it were sunk there would be no lives lost with it, for it carries no human crew.

But what if the enemy confronted by the wirelessly operated craft should have a similarly tuned and more intense wireless equipment with which to turn it back upon its own mines, or make it fire upon its own port?

Will the naval battles of the future depend for their outcome on a superiority of wireless equipment?

These conjectures are but a slight forecast of the many interesting problems opened up by the ingenious Christopher Wirth with his successful wireless boat directing, which in itself is probably the most epoch-making of all the experiments of recent years affecting naval progress.

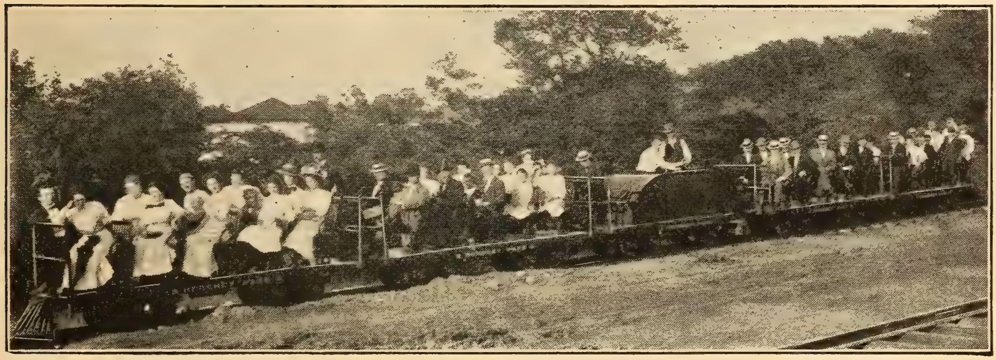
Miniature Trolley Train

Electricity's inroads on the domain of the steam train do not stop with the trolley lines. As further testifying to the preference of the general public for the electric locomotive a miniature electric railway constructed at Hersey Park, N. Y., entertains a larger crowd than any other of the numerous attractions.

This miniature railway, which is probably the only one of its kind in the United States, runs on a narrow gauge track around the grounds and collects its power from a regular third rail, involving the same shoe arrangement as is seen on the standard type of passenger cars. The electric locomotive is set on miniature trucks made to order after the pattern of the larger ones and is run by two motors. The control consists of a regular motorman's controller and the whole train of four cars and the locomotive is run by a single individual.

The train will average from eighteen to 20 miles an hour carrying a crowd of 50 people. The current carrying third rail is protected and it will be noticed that the locomotive is run in the center of the train, as by this method some operating advantages are obtained.

BOAT-CONTROLLING WIRELESS STATION



MINIATURE THIRD RAIL ELECTRIC RAILWAY

The Beginnings of the Telephone

"In that somewhat distant year 1875, when the telegraph and the Atlantic cable were the most wonderful things in the world, a tall young professor of elocution was desperately busy in a noisy machine shop that stood in one of the narrow streets of Boston, not far from Scollay Square. It was a very hot afternoon in June, but the young professor had forgotten the heat and the grime of the workshop. He was wholly absorbed in the making of a nondescript machine, a sort of crude harmonica with a clock-spring reed, a magnet, and a wire. It was a most absurd toy in appearance. It was unlike any other thing that had ever been made in any country. The young professor had been toiling over it for three years and it had constantly baffled him, until, on this hot afternoon in June, 1875, he heard an almost inaudible sound—a faint twang—come from the machine itself.

"For an instant he was stunned. He had been expecting just such a sound for several months, but it came so suddenly as to give him the sensation of surprise. His eyes blazed with delight, and he sprang in a passion of eagerness to an adjoining room in which stood a young mechanic who was assisting him.

"'Snap that reed again, Watson,' cried the apparently irrational young professor. There was one of the odd-looking machines in each room, so it appears, and the two were connected by an electric wire. Watson had snapped the reed on one of the machines and the professor had heard from the other machine exactly the same sound. It was no more than the gentle twang of a clock spring; but it was the first time in the history of the world that a complete sound had been carried along a wire, reproduced perfectly at the other end, and heard by an expert in acoustics.

"That twang of the clock-spring was the first tiny cry of the newborn telephone, uttered in the clanging din of a machine-shop and happily heard by a man whose ear had been trained to recognize the strange voice of the little new-comer. There, amidst flying belts and jarring wheels, the baby telephone was born, as feeble and helpless as any other baby, and 'with no language but a cry.'"

So opens the first chapter of a new and wonderfully interesting book which has just been published by A. C. McClurg & Co., of Chicago. The title of the book is "The History of the Telephone" and its author Herbert N. Casson. Mr. Casson has once again demonstrated his ability to take the historical facts connected with a more or less abstruse mechanical subject and weave them into a story of absorbing interest.

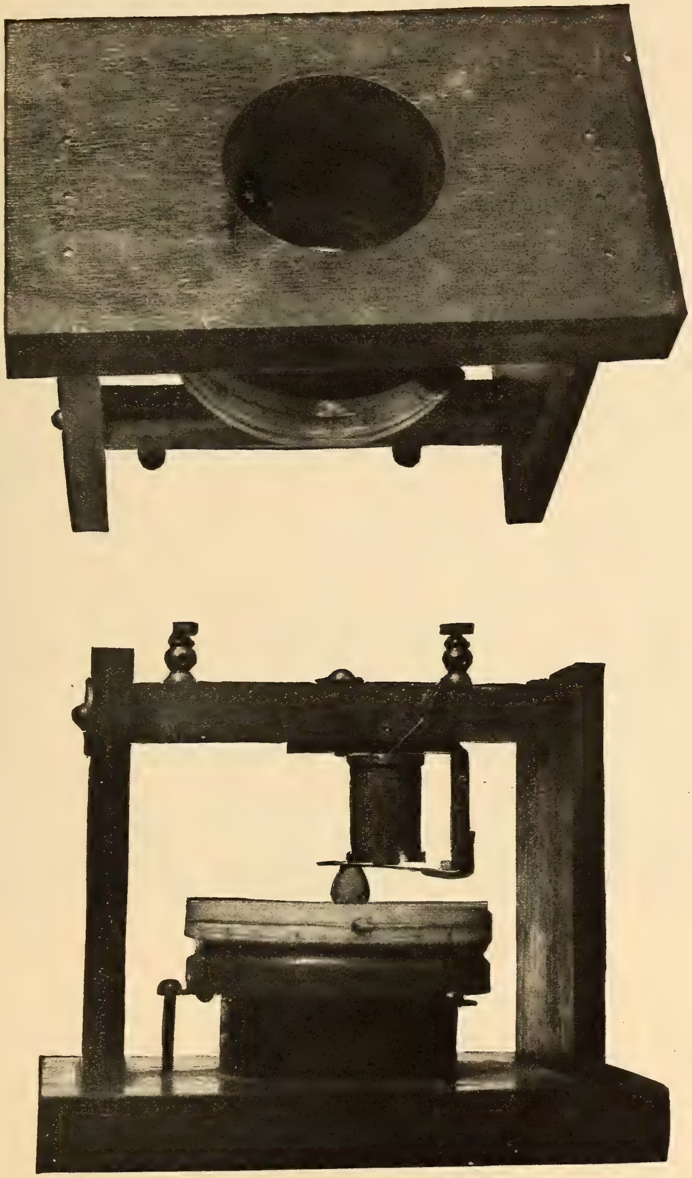
The history of the telephone, which was invented by Alexander Graham Bell at a time well within the memory of many of the readers of this magazine, embodies a series of events, many of them spectacular, many of them romantic, which go into the making of a book which, to use a common expression "reads like a novel."

To quote again from the book:

"In the early summer of 1874, while he [Bell] was puzzling over his harp apparatus, [first suggested to him by Helmholtz's experiments with tuning forks vibrated by electro-magnets] the dim outline of a new path suddenly glinted in front of him. He had not been forgetful of 'visible speech' all this while, but had been making experiments with two remarkable machines—the phonautograph and the manometric capsule, by means of which the vibrations of sound were made plainly visible. If these could be improved, he thought, then the deaf might be taught to speak by sight—by learning an alphabet of vibrations. He mentioned these experiments to a Boston friend, Dr. Clarence J. Blake, and he, being a surgeon and an aurist, naturally said, 'Why don't you use a real ear?'

"Such an idea never had, and probably never could have, occurred to Bell; but he accepted it with eagerness. Dr. Blake cut an ear from a dead man's head, together with the ear drum and the associated bones. Bell took this fragment of a skull and arranged it so that a straw touched the ear drum at one end and a piece of moving smoked glass at the other. Thus, when Bell spoke loudly into the ear, the vibration of the drum made tiny markings upon the glass.

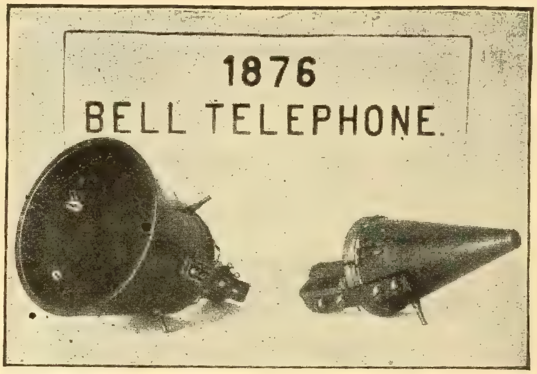
"It was one of the most extraordinary incidents in the whole history of the telephone. To an uninitiated onlooker, nothing could have been more ghastly or absurd



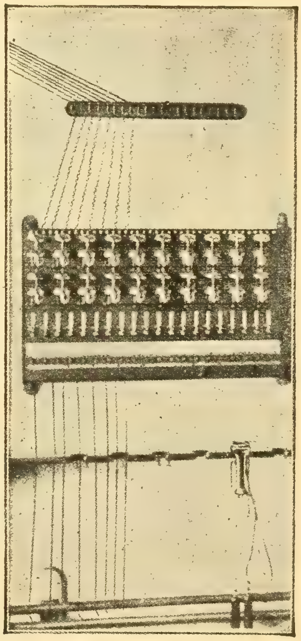
ALEXANDER GRAHAM BELL'S FIRST TELEPHONE

By Courtesy of A. C. McClurg & Co.

How could any one have interpreted the gruesome joy of this young professor with the pale face and the black eyes, who stood earnestly singing, whispering and shouting into a dead man's ear? What sort of a wizard must he be, or ghoul, or madman? And in Salem, too, the home of the witchcraft superstition! Certainly it would not have gone well with Bell had he lived two centuries earlier and been caught at such black magic.



FIRST BELL TELEPHONES, PHOTOGRAPHED FROM THE ORIGINAL INSTRUMENTS IN THE PATENT OFFICE AT WASHINGTON



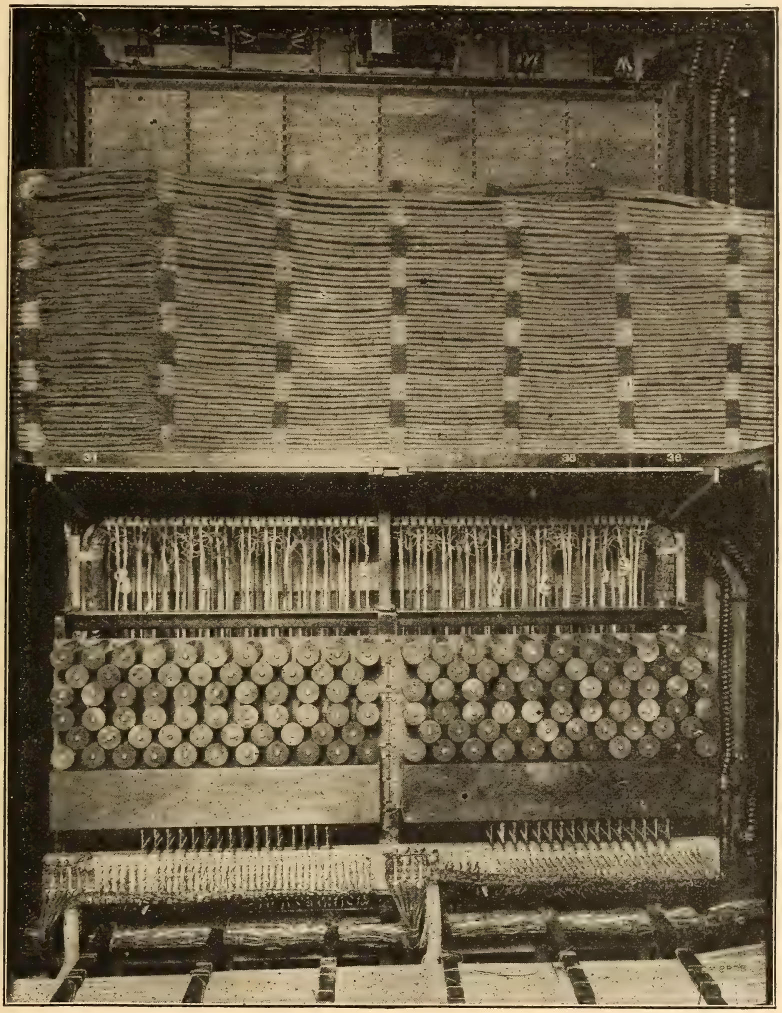
FIRST EXCHANGE SWITCH BOARD WITH TWENTY CIRCUITS EQUIPPED IN 1878

By Courtesy of A. C. McClurg & Co.

"What had this dead man's ear to do with the invention of the telephone? Much. Bell noticed how small and thin was the ear-drum, and yet how effectively it could send thrills and vibrations through heavy bones. 'If this tiny disk can vibrate a bone,' he thought, 'then an iron disk might vibrate an iron rod, or at least, an iron wire.' In a flash the conception of a membrane telephone was pictured in his mind. He saw in imagination two iron disks, or ear-drums, far apart and connected by an electrified wire, catching the vibrations of sound at one end, and reproducing them at the other. At last he was on the right path, and had a theoretical knowledge of what a speaking telephone ought to be. What remained to be done was to construct such a machine and find out how the electric current could best be brought into harness."

Having arrived at this stage, as if Fortune felt that he was winning success too easily, Bell met with a serious setback. Two men, Gardiner Hubbard and Thomas Sanders, who had been backing him financially said they would pay no more unless he confined his experiments to the musical telegraph and stop wasting his time on ear toys. Bell wished to marry the daughter of Hubbard, and his prospective father-in-law even withdrew his consent to the marriage unless Bell abandoned the "foolish telephone."

Bell was poor, very poor, for he had given up his lucrative position of professor in Boston University. While stumbling through this Slough of Despond he was called to Washington by his patent attorney and finally reached there by borrowing the price of a return ticket



BACK SECTION OF MODERN SWITCHBOARD

By Courtesy of A. C. McClurg & Co.

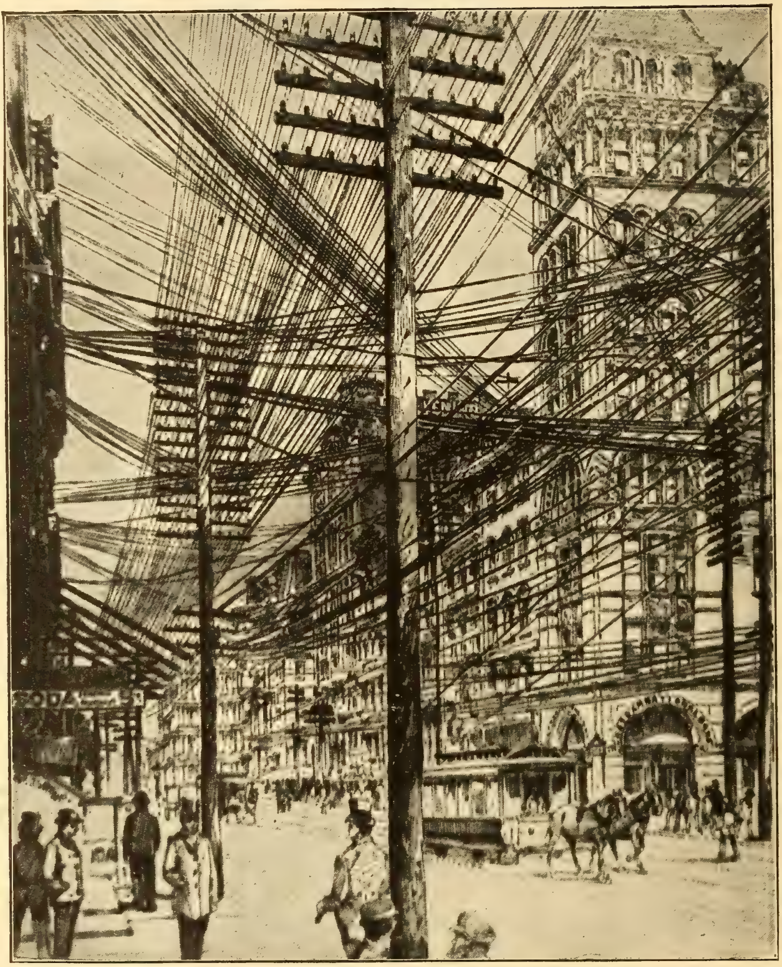
from Hubbard. At Washington Bell went to Professor Joseph Henry, who then knew the theory of electrical science better than any other American and showed him his apparatus. The great scientist said :

"You are in possession of the germ of a great invention and I would advise you to work at it until you have made it complete."

"But," replied Bell, "I have not the electrical knowledge that is necessary."

"Get it," responded the aged scientist.

These few words encouraged Bell wonderfully and again he went to work. To continue again in the words of the book: "For forty weeks—long exasperating weeks—the telephone could do no more than gasp and make strange inarticulate noises. Its educators had not learned how to manage it. Then, on March 10, 1876, it talked. It said distinctly, 'Mr. Watson, come here, I want you.' Watson who was at the lower end of the wire, in the basement, dropped the receiver and rushed with wild joy up three flights of stairs to tell the glad tidings to Bell. 'I can hear you!' Watson shouted breathlessly. 'I can hear the words.'



FROM A PHOTOGRAPH

BROADWAY AND JOHN STREET, NEW YORK, IN 1890, SHOWING THE DENSITY OF OVERHEAD WIRES

By Courtesy of A. C. McClurg & Co.

"It was not easy, of course, for the weak young telephone to make itself heard in that noisy workshop. No one, not even Bell and Watson, were familiar with its odd little voice. Usually Watson, who had a remarkably keen sense of hearing, did the listening; and Bell, who was a professional elocutionist, did the talking. And day by day the tone of the baby instrument grew clearer—a new note in the orchestra of civilization.

"On his twenty-ninth birthday, Bell received his patent, No. 174,465—'the most valuable single patent ever issued' in any country. He had created something so entirely new that there was no name for it in any of the world's languages. In describing it to the officials of the Patent Office, he was obliged to call it 'an improvement in telegraphy,' when in truth, it was nothing of the kind. It was as different from the telegraph as the eloquence of a great orator is from the sign-language of a deaf-mute."

As though the very stars in their courses were working for this young wizard with the talking wire, the Centennial Exposition in Philadelphia opened its doors exactly two

BROADWAY AND JOHN STREET, NEW YORK, AS IT APPEARS WITHOUT OVERHEAD WIRES

By Courtesy of A. C. McClurg & Co.

months after the telephone had learned to talk. Bell felt that he could not afford to go. But one Friday afternoon, toward the end of June his sweetheart, Mabel Hubbard, was taking the train for the Centennial, and he went to the depot to say good-bye. Upon finding out for the first time that he could not go she coaxed and pleaded with him. Finally like a true Sir Galahad, he dashed after the moving train and sprang aboard without ticket or baggage.

"As it happened, this impromptu trip to the Centennial proved to be one of the most timely acts of his life. On the following Sunday afternoon the judges were to make a special tour of inspection and Mr. Hubbard, after much trouble had obtained a promise that they would spend a few minutes examining Bell's telephone. By this time it had been on exhibition for more than six weeks, without attracting the serious attention of anybody.

"When Sunday afternoon arrived, Bell was at his little table, nervous, yet confident. But hour after hour went by and the judges did not arrive. The day was intensely hot, and they had many wonders to examine. There was the first grain-binder, the musical telegraph of Elisha Gray, and the marvellous exhibit of printing telegraphs shown by the Western Union Company. By the time they came to Bell's table, through a litter of school desks and blackboards, the hour was seven o'clock, and every man in the party was hot, tired and hungry. Several announced their intention of returning to their hotels. One took up a telephone receiver, looked at it blankly, and put it down again. He did not even place it to his ear. Another judge made a slighting remark which raised a laugh at Bell's expense. Then a most marvellous thing happened—such an incident would make a chapter in 'The Arabian Nights Entertainments'.

"Accompanied by his wife, the Empress Theresa, and by a bevy of courtiers, the Emperor of Brazil, Dom Pedro de Alcantara, walked into the room, advanced with both hands outstretched to the bewildered Bell, and exclaimed: 'Professor Bell, I am delighted to see you again.' The judges at once forgot the heat and fatigue and the hunger. Who was this young inventor with the pale complexion and black eyes, that he should be the friend of Emperors? They did not know and for the moment even Bell himself had forgotten, that Dom Pedro had once visited Bell's class of deaf mutes at Boston University. He was especially interested in such humanitarian work and had recently helped to organize the first Brazilian school for deaf mutes at Rio de Janeiro. And so, with the tall, blond-bearded Dom Pedro in the centre, the assembled judges and scientists—there were fully 50 in all—entered with unusual zest into the proceedings of this first telephone exhibition..

"A wire had been strung from one end of the room to the other, and while Bell went to the transmitter, Dom Pedro took up the receiver and placed it to his ear. It was a moment of tense expectancy. No one knew clearly what was about to happen, when the Emperor, with a dramatic gesture raised his head from the receiver and exclaimed with a look of utter amazement: "*My God—it talks*!"

"Next came to the receiver the oldest scientist in the group, the venerable Joseph Henry, whose encouragement to Bell had been so timely. He stopped to listen, and, as one of the bystanders afterwards said, no one could forget the look of awe that came into his face as he heard that iron disk talking with a human voice. 'This,' said he, 'comes nearer to overthrowing the doctrine of the conservation of energy than anything I ever saw.'

"Then came Sir William Thomson, latterly known as Lord Kelvin. It was fitting that he should be there, for he was the foremost electrical scientist at that time in the world, and had been the engineer of the first Atlantic cable. He listened and learned what even he had not known before, that a solid metallic body could take up from the air all the countless varieties of vibrations produced by speech, and that these vibrations could be carried along a wire and reproduced exactly by a second metallic body. He nodded his head solemnly as he rose from the receiver. 'It does speak,' he said emphatically. 'It is the most wonderful thing I have seen in America.'

"So one after another, this notable company of men listened to the voice of the first telephone, and the more they knew of science, the less they were inclined to believe their ears. The wiser they were the more they wondered. To Henry and Thomson, the masters of electrical magic, this instrument was as surprising as it was to the man in the street. And both were noble enough to admit frankly their astonishment in the reports which they made as judges, when they gave Bell a Certificate of Award. 'Mr. Bell has achieved a result of transcendent scientific interest,' wrote Sir William Thomson. 'I heard it speak distinctly several sentences . . . I was astonished and delighted . . It is the greatest marvel hitherto achieved by the electric telegraph.' "

These few brief extracts show the kind of reading in the new book. It goes on to recount the early difficulties in making the telephone a commercial proposition; tells of the brilliant men who took up its cause, perfected it, financed it, and added the business brains; the beginnings of long-distance telephony; the development of the art down to the present time. All along, the story is told in the same simple, entertaining style which characterizes the opening paragraphs.

◆

The Flying Scarab and the Seventh Heaven

By RENE MANSFIELD

I.

Fletcher Kent, inventor among other things of Kent's Aeromotor Muffler and Kent's system of aero-telephony, as well as a successful sustainer; champion aviator of a continent or two and unwilling idol of several more—Fletcher Kent, in pale blue pajamas was treading the greensward with pink, dew-drenched feet, in the early dawn of a June day. In his left hand he held a spray of wild roses which he frequently sniffed; with his right he steadied the pail of spring water that rested upon his shoulder.

Click—click! The enterprising eye of the *Daily Sun*, concealed behind a bush near by, winked impudently at Fletcher Kent. The world and his wife at breakfast next morning would gaze delighted at a picture of the famous flyer in his robe de nuit, feet au naturel, and presenting the appearance of a bifurcated Rebecca at the well.

Splash—and again splash!

"Oh, that's all right, Mr. Kent," spluttered Dawson of the *Sun*, as he emerged from behind the bush, pouring the spring water from the gulleys of his soft hat, and sopping it up with a couple of handkerchiefs from his coat. "Don't mention it. It didn't hurt the camera in the least."

"Now you get out of here," roared Kent. "Is a man never to have a blamed minute's privacy, without some of you fellows on his trail? I tell you it's outrageous!"

"Sorry you feel that way about it, Mr. Kent," said Dawson serenely, tucking his camera under his arm and starting for the cowpath that led to the main road. "Orders is orders, you know."

Horrid visions of the fantastic film that reposed in the reporter's camera cooled Kent's ire for a moment.

"See here, Dawson," he began, setting his pail down with determination and absently sticking the spray of roses in the pocket of his garment, "see here, now, you can't use a picture like that, you know—really you can't. Absurd! Ridiculous!—But of course, you're not seriously intending to?" Kent summoned a feeble, wheedling laugh.

Dawson lifted his water-soaked hat with difficulty, but with elegance.

"Good morning, Mr. Kent," he responded pleasantly as he struck off down the road.

"But I won't have it—I tell you I won't have it," cried Kent to Dawson's retreating back. Dawson gave every indication of considering the conversation closed. "Oh, well," flung Kent, picking up the empty pail with violence. "Print it and be damned!"

"Thank you for your kind permission," acknowledged Dawson sweetly from over his shoulder.

Kent strode into the sleeping-tent with choler in his bosom that wilted the flower in his breast pocket. Butler, his wireless telegraph operator, sat on the edge of the air mattress pulling on his shoes with early morning languor.

"I tell you, Butler, I won't stand it!" Kent sat down on the top of a trunk with emphasis.

"Well, wha'smatter now?" inquired Butler sleepily.

"Matter? Do you think you'd get any keen pleasure in having your picture scattered over the country in *these*? Heroic garb for a man who calls himself a scientist, is it not? 'Kent taking the Kneipp cure,' I suppose they'll label it, or 'the aviator at off moments,' or——"

"Good Lord!" broke in Butler, sitting up, "did they get you that way?—'With a rose in his buttonhole'—" he sang.

Kent snatched the wilted blossom from his pocket. "You may be able to find some humor in the affair, Butler, but I swear I don't. Came out to this forlorn old prairie to escape the press and experiment in peace. Very first morning when I arise with the birds—how could you sleep through their clatter, Butler?—and saunter out to the spring with a yearning to get near to nature, and without the formality of dressing, behind the bushes at 5 a. m. lurks one of those rascally reporters——"

"Good heavens, Kent, you're as fussy as the old lady Godiva. Didst pluck out the eyes of the varmint?"

Kent grinned. "No, but I dashed cold water on any hopes he may have entertained —nice, clear, cold water from the spring.

But, I say, Butler, I'm going to outwit those chaps somehow, I don't propose to be dogged to death about this thing we're working on now. I won't give up a word about that till I'm good-and-ready, if they line up four deep around here." Kent's jaw took on the expression that had inspired the *Sun* to speak of "the fighting face of the man who had flown from ocean to ocean, waging constant battle with the crafty elements."

"By George, Butler," he exclaimed after a minute's thought, "let's disappear!"

"I'm on," said Butler, succinctly.

And so they did. Two mornings after the *Daily Sun* made extended mention of it.

"Fletcher Kent, with Albert Butler, wireless expert, has suddenly left Plainville where he had gone to conduct experiments along an entirely new line, the nature of which have not as yet been disclosed. There is some mystery about their disappearance, as, although their camping outfit is gone, as well as the famous Flying Scarab, inquiry of the Plainville station agent established the fact that no shipment had been made from the village for several days. Friends of the aviator know nothing of his whereabouts and some concern is felt," etc., etc.

II.

"Gad, if I were a poet!" breathed Fletcher Kent. Above him, a cloudless, fathomless blue; below him a swift flowing sea of verdure, the fields like golden crests on the emerald waves of the luxurious country. Now and again a farmhouse appeared for a moment like a bit of bark riding the undulating hills; here and there a river gleamed like a silver-moted moonbeam. The Flying Scarab was the only aerial craft navigating the pathless waste for miles around.

Although he spent most of his waking hours in the air, Kent never failed to experience an exhilarating sense of power, mingled with awe, when he realized that he was coursing through long-forbidden and unexplored areas, where only the birds might question his right of way. The day was perfect. The upper currents of air were steady, the lower just breathed on the tree tops, stirring them gently.

Being unfamiliar with that section of the country, Kent dipped his elevating plane slightly and dropped several hundred feet to sight the land marks he had noted. Presently what seemed a black snake, emitting a vapory breath, and winding through the green, he knew to be a long train of cars, and soon the cliff-fringed eye of Polar Lake was beneath him. Across its placid surface he skimmed, headed for the cliff whose steep sides reared their wooded crests high above the surrounding shore line.

While still above the lake Kent shut off his power and glided easily to the plateau-like clearing at the summit of the cliff. So well had he gauged his descent that the wheels beneath the machine scarcely made a single revolution after touching the ground. Kent leaped from his seat. Then he clutched a lever and leaned against a sustainer for support. Before him stood an angel, or a dream, or a dryad priestess, or some such divinity. Angels, he reflected, were not in the habit of displaying round, brown ankles beneath snug fitting tailored skirts, and above trim brown shoes. Dreams, as he recalled them, were pale and pasty affairs, showing none of the tanned detail of the plump arms, and hands clasped in wonderment before him, like a child's. A dryad priestess would scarcely wear her hair in a red-brown braid swung over a bosom that rose and fell excitedly beneath a soft shirt with a turn-down collar.

By this process of elimination it would seem that it might be a real girl standing before him here on a cliff of Polar Lake, miles, as he had supposed, from any habitation. Then the brown of her little feet, and the gold glint of her wind-blown hair, against the fluttering foliage, made him think of autumn leaves and the elusive swaying of slim branches.

"Might you be Miss Daphne?" he asked finally, not at all certain of his mythology.

"Might *you* be Mr. Mercury?" she inquired in return.

"This *might* be Mount Olympus," he affirmed decisively, including in his admiring glance the lake like a sapphire far beneath, the woods behind like a huge velvet throne against a curtain of turquoise—and the girl like a wood nymph startled by a faun.

"It is the Seventh Heaven," the girl stated simply.

"It is," Kent agreed devoutly.

"Have you a passport, Mr. Mercury?" she demanded demurely.

Kent racked his scientific brain for a poetic response. Mythology and poesy failed him. But strategy came to his aid.

"MIGHT YOU BE MISS DAPHNE?" HE ASKED

"I have not, Miss Daphne, I'll go back at once to get one." He made as if to resume his seat in the Flying Scarab. "Careless of Jove to send me off like that. I beg your pardon for my intrusion——" he was manipulating a couple of levers industriously.

The girl laughed, and put a tanned little hand on the white stretch of the elevator.

"Please, Mr. Mercury—would you mind not being a divinity for a little while? You see, I've never seen an aeroplane. I know that's queer, in this day and age—but I haven't been out of the village for a year, since I came back from school. I'd—I'd like to ask a few questions if—if——"

Kent interrupted her with a magnificent wave of his hand toward the passenger's seat of the Flying Scarab.

"If the high priestess of the Seventh Heaven will deign to seat herself on Mercury's winged steed—or was it his feet that were winged?—oh, hang the ancients, I'm getting all balled up. If you'll allow me, my name is——"

"Mr. Mercury will do very well," put in the girl coolly, as she smilingly seated herself in the seat he had pointed out, and began to examine with interest the levers and instruments.

Kent was grateful that he had not been permitted impulsively to divulge his name. "Perhaps it will be better, Miss Daphne," he acquiesced. The girl turned to look at him a bit sharply. "And I'm going to ask you if you will please not mention in the village the fact that a strange bird lit in your Seventh Heaven. You see, my assistant and myself have grave reasons for wishing to remain undiscovered as long as possible. It's not an easy thing to do with a white flyer like this on one's hands. We've pitched camp down the side of the bluff a ways—I had the deuce of a time getting up in the air this morning, too. I may depend upon you not to betray us, Miss Daphne?"

"But you might be flying from justice or jail or something," she objected.

"As a matter of fact, we are flying from the pen," he punned back recklessly. "The pitiless pen of the press. It's this way, Miss Daphne," he went on for the sole purpose of keeping a pair of laughing eyes upturned to his, "I'm working out a very delicate experiment, which may mean something tremendous—or may fail absolutely," he added with modesty, but with a total lack of conviction. "My assistant and I thought we'd try disappearing, so we could conduct our final tests in peace, without being pestered into premature statements by zealous reporters. This place being about five miles from the village—isn't it—," the girl nodded, "and the village being without a railroad seemed to furnish as safe a retreat as any."

"But even in this out-of-the-way place you can't expect to remain very long undiscovered," the girl suggested.

"No. But it's only a matter of a few days before I'll be ready to give out a statement, I think. I've a good notion to make 'em tramp from the village up here to the heights—those pesky newspaper men—with your permission, Miss Daphne." The girl seemed highly amused at the picture of a reportorial squad kicking up five miles of desert dust and clambering up to the Seventh Heaven.

Kent looked at her suddenly with curiosity. "But you—how do you——" he began.

The girl pointed to a narrow trail scarcely discernible in the thick woods behind her. "At the end of that path down near the road," she replied, "is tethered my prehistoric steed. It's got pedals and rubber tires and a handle bar."

"A bicycle, by Jove!" cried Kent as though she had spoken of riding a pterodactyl.

"Have you seen the village yet?" she asked abruptly.

"No."

"If you ever do, you'll understand why I call this the Seventh Heaven. I'd die if I couldn't pedal out here every day, that's all."

"That's almost too good to be true," said Kent, beaming. The girl raised her eyebrows in haughty inquiry. Kent sensed the delicacy of the situation. "Won't you let me drop in on you occasionally up here in your Seventh Heaven?" he pleaded tactfully.

She ignored the question. "And when you want to go up you turn the planes this way?" she inquired, having discovered that a light push on the lever operated the planes.

Kent explained in detail the workings of the machine and of the wireless telegraph and telephone. He was amazed at the quick comprehension of the girl and the intelligence with which she questioned him. He sighed for more theories to expound.

Presently she glanced up at the sun with speculating eye. "O, I must be getting back. Thank you so much for your kindness in explaining things to me," she said simply, as she turned toward the little trail that led through the woods.

"But—but you will come tomorrow?" stammered the eminent scientist and aviator, not daring to follow her, but in a panic for fear he might not see her again.

"It is *my* Seventh Heaven," she reminded him.

"Which I'm going to construe as a promise," he replied. "And, Miss Daphne, you won't let fall a word, you know—you can't ever tell about those reporters—they're liable—"

"You needn't worry, Mr. Mercury. I'll do my best to keep them away from you," she called over her shoulder as she pushed back a low hanging bough across her path, which swung back in place again, hiding her from the eager eyes of Fletcher Kent.

III.

"Good afternoon, Miss Daphne."

"Good afternoon, Mr. Mercury." The girl raised her eyes for a moment from the book she was reading; then settled herself more comfortably in the low tree crotch that formed a natural seat, and turned a page with strict attention to the performance thereof.

Kent fussed with his engine; clicked out a few wireless messages; sternly inspected the propellers and the planes and then sat down in the seat of the Scarab and ruefully inspected the silent young sphinx in the tree crotch.

After a time, when the pink in her cheeks had mounted to the roots of her red-brown hair, she glanced down at Kent as though quite unconscious of his manuevers and inquired, "Would you please tell me if you can use the smallest stop with bulb exposures? I've just been given a camera and I'm reading up on how to use it."

Kent bounded from the Scarab, unstrapped his own camera from its position in front of the swinging seat beneath the machine, flung himself on the grass beside the tree in which she was sitting, and launched forthwith into the rules and rudiments of plain and fancy photography.

The girl's austere formality vanished by degrees. Eventually she slipped down from her leaf shaded seat and sat beside him on the grass.

"I don't happen to have any films to load this up," he was saying, "but you see you set this for the exposure, and have the shutter so—and now you are all ready to take a picture—if it is properly loaded, of course."

"Seems simple, doesn't it?" said the girl, peering into the finder. "Oh, dear, Mr. Mercury, there goes my handkerchief—it's dreadfully windy today, isn't it—there, over there by that ash——oh, it has blown down the cliff? Don't bother—please."

But Kent, having started in pursuit of the elusive, dainty square, plunged down the side of the cliff and was some little time recovering it. When he appeared again the girl was still diligently gazing into the finder with the camera focused on the Scarab.

"Thank you very much. Now, if I wanted to snap the aeroplane—see, but I can't get it all in. And of course the seat shouldn't be in the exact center, 'cording to art, should it? Do please sit in it and wave your handkerchief so I can tell where the center is, anyway." Kent did solemnly as he was directed. "I can see that all right," she laughed. "Now, I should set this, press the bulb so"—click!—"and what a pity it isn't loaded!" she finished, as he arose.

Kent grinned grimly. "I'm afraid I shouldn't have been quite so docile if it had been," he said.

The girl tripped about, trying to focus the camera on the picturesque views disclosed on every side, Kent offering profound suggestions at her elbow.

"What a magnificent view it would be from down there on that little point, looking up toward the cliff," she cried excitedly. "You see I'm turning into a camera fiend."

"So long as it isn't a laurel bush, it's all right, Miss Daphne," returned Kent, fatuously, as they plunged down the cliff to the spot she had indicated. "You can just see our camp from here," Kent pointed out, "down there in that clearing. If you would care to walk down, I'd like to show you our telephone station and some other apparatus——" he began tentatively.

"Oh, I should so like to see them," the girl agreed enthusiastically.

So they clambered down the rugged cliff, catching at sturdy shoots and bits of rock to keep from slipping on the treacherous sand. Very often Kent leaped ahead of her and extended a steady hand in lieu of the swaying shoots, which she grasped occasionally with strict impartiality.

Before the tent which they came upon soon, sat Butler. He was unable to conceal his surprise at the sudden appearance of the two. He stared at the girl as though she were a sprite whom Kent in his aerial wanderings had plucked from another world.

"Miss Daphne," said Kent, "let me present Mr. Butler—my wizard of the wireless," he added laughingly.

"Miss Daffney," acknowledged Butler stupidly.

The girl smiled at him winningly. "You've no idea how picturesque you looked just now, Mr. Butler, sitting there with the tent and the wood there and all. Mr. Mercury" —with a mischievous little giggle—"Mr. Mercury has been letting me use his camera for a sort of dress rehearsal, you see, because I just got one and I don't know the first thing about using it." She reached for the camera tucked under Kent's arm. "Do let me see what a stunning picture that would make," she begged, stepping back a few steps to focus on the tent. "Oh, I could almost get both of you in. Do stand just a little bit nearer." She cast imploring eyes at Kent. Butler looked at Kent oddly.

"It isn't loaded," Kent reassured him, smiling, as he complied amiably.

"No, isn't it a pity?" she babbled on. "I'd just have to push this and poke this and squeeze this, and there you'd be!"

"I told Miss Daphne I'd show her the workings of some of our instruments," Kent explained presently. "The wireless is right back of the tent here."—"Lives in the village—doesn't know an induction coil from a hairpin. What's the matter with you?" he found a chance to whisper into the ear of Butler who had made no attempt to conceal his surliness. He stood by impatiently while Kent answered the girl's flood of questions as he sparked off messages for her on the little wireless instrument. After a time Butler sauntered over to a rough table near by that was littered with various experimental apparatus—Leyden jars—intricate tracings of copper wire on wooden framework—metal wheels that revolved at every degree of speed—dynamometers and a series of peculiar indicators, which he examined closely.

The girl, happening to glance up as Butler was scowlingly scrutinizing the last of these, saw him suddenly bend close, stare intently at the indicator, then raise his head with a wonderful light in his eyes.

"Kent!" he called, "Kent, come here!" His voice was not quite steady. Kent was beside him at one bound, examining the indicator with suppressed excitement. In a moment he turned to Butler, and putting a hand that trembled upon his shoulder he said hoarsely, "We've got it, old boy—we've got it!"

(To be Concluded.)

Sleet on Aluminum Lines

In many of the northern states severe sleet storms load down telegraph, telephone and electric transmission lines to the breaking point, with ice which freezes around the wires as it falls. Because aluminum wire must have twice the cross-section of an equivalent copper wire has been one of the arguments against its use on transmission lines, the assumption being that its greater surface area would collect heavy loads of ice. However, an engineer who has made a comparison of copper and aluminum wire lines observes that the aluminum lines withstand heavy storms much better than those of copper. He explains this by stating that the surface coat of aluminum hydroxide gives the metal an oily feeling and drops of water striking the wire are not able to stay long enough to be frozen.

Dredging on the Yukon

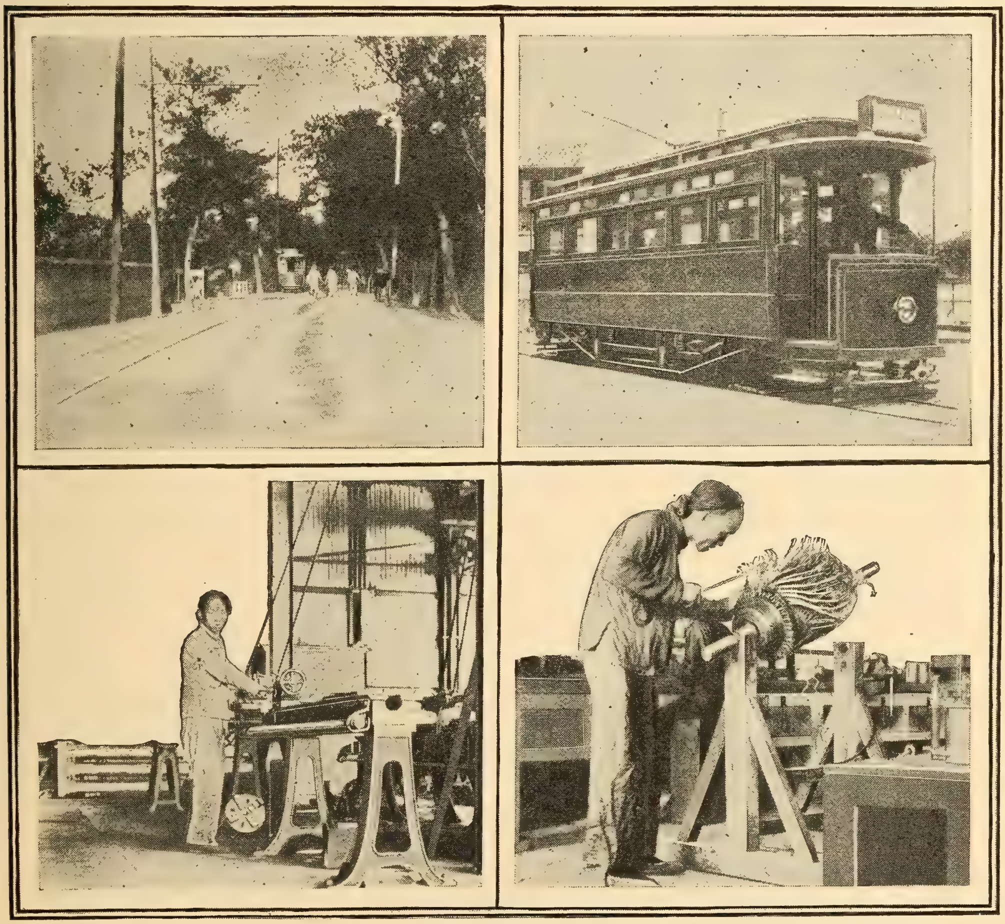
At Dawson, the wonderful camp on the Yukon, up in Yukon Territory, one of the largest dredges in the world has been placed in commission. It belongs to the Canadian Klondike Company, and is one of its fleet, now in the big river of the north, engaged in digging gravel and sifting the golden treasure from the deposits of ages. The construction was begun in August and the boat completed in November. The machinery is from an American dredge and steam-shovel works. The boat has been named the *Canadian* and is 130 feet long by 91 feet wide.

It is operated by electrical power and has a capacity of 10,000 cubic yards a day. It is now located in one of the richest dredging tracts in the world and is expected to recover a vast amount of gold.

Teaching Chinese Electric Railroading

By C. B. EDWARDS

Connecting the thickly populated outskirts of Shanghai, China, through its ancient gateways with the narrow little streets of one of China's greatest seaports, the tramway system of Shanghai may be acclaimed the most modern electric railway in this eastern empire.



Street Scene in Shanghai
Chinese Machinist

Typical Motor Car
Armature Worker

GLIMPSES OF CHINESE ELECTRIC RAILROADING

After successfully meeting the exacting conditions of the Chinese government in the foundation of this electric road the foreign promoters have gradually increased the importance of the Shanghai Tramway till at the present time, two years after the first car went rattling up a narrow Shanghai thoroughfare before a wondering throng of native population, the road ramifies throughout the most populous districts of Shanghai and includes 26 miles of track, and a rolling stock of 65 electric cars. In the founding of such a system, among a people whose customs have remained unchanged for untold centuries, a wonderful task was carried out. On account of China's backwardness in carrying through a project such as an electric railway the initiative is all thrown on the shoulders of foreign nations anxious to

THE CHINESE RAILWAY MEN MUST BE PHYSICALLY FIT

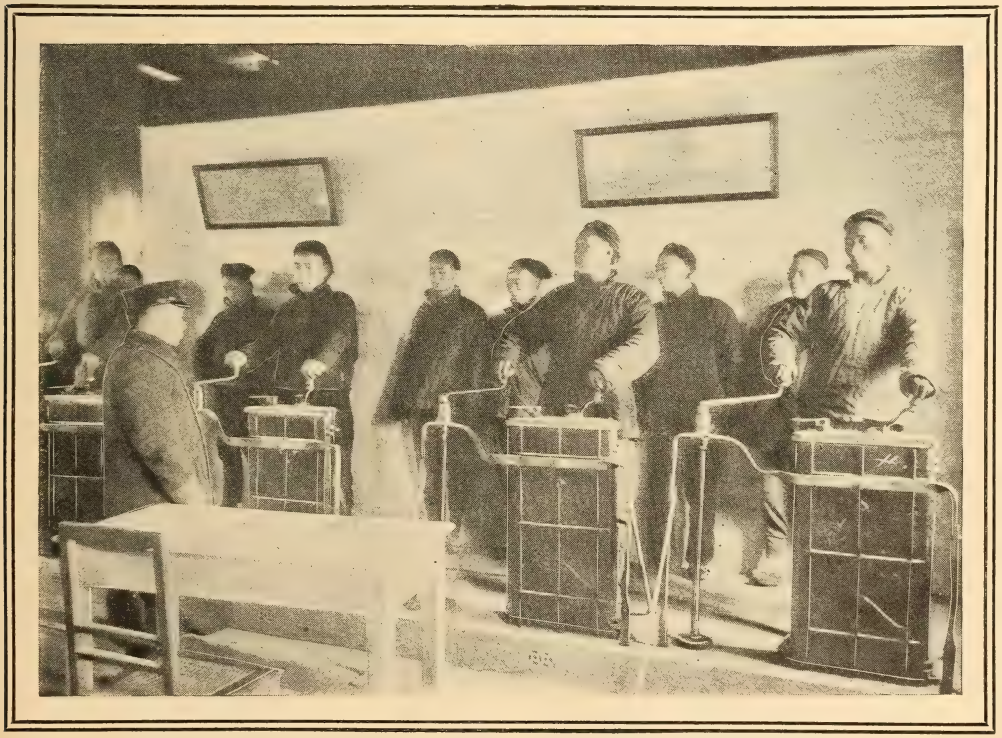
handle China's trade and for this reason it fell to the British interests to put through the Shanghai road.

In almost all foreign concessions with regard to the building of railroads, the Chinese government not only reserves for itself the ultimate reversion of the railway lines and their equipment, with no compensation, but also the larger share of the profits. Provision for Chinese control is also made in all cases, for the fear of foreign interference is strong among the Mongolians and the foreign syndicate obtaining a railway concession is permitted only to construct and operate the road. The government also assures itself of the ultimate native control of the road by requiring each foreign syndicate to maintain a school for the instruction of young Chinese in the railway business. The foreign syndicate receives five per cent on the capital invested and one-fifth of the net profits, the remaining four-fifths being divided equally between the native syndicate and the Chinese government. Through this procedure the government secures 40 per cent of the net profits and the final reversion of the road, in addition to the privilege of transporting troops and ammunition at half rates.

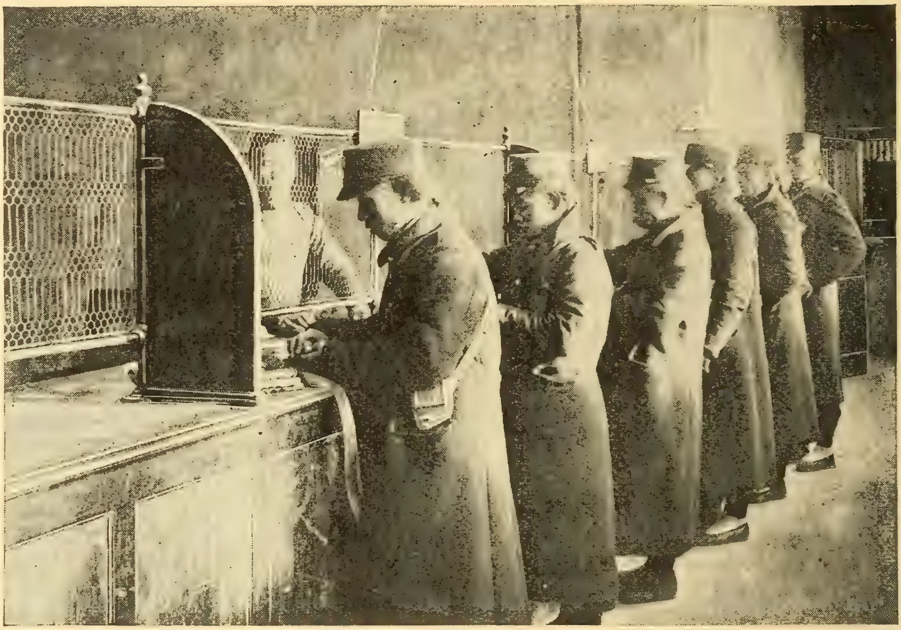
It can be safely said, that no electric railway in the United States could be either built or operated under such government rulings and native conditions existing in China when the Shanghai Tramways were first put in commission. The really wonderful part of it all is that the road is not only flourishing but is adding to its mileage each year new trackage opening up new territory.

The government provision requiring the hiring of Chinese employees by the Shanghai Tramway Company made the project assume a dubious turn but with the instruction of the native Chinese the operators of the road have found that the Mongolian is easy to teach and possesses a wonderful memory for detail unequalled by railway employees in the United States. No doubt the outlook was discouraging when an English engineer took up the running of the road and saw before him as prospective motormen and conductors a long line of uncleanly China-men who not only knew absolutely nothing about an electric car but were even slightly awed by the car which moved at the command of an invisible force. The temperament of the Chinese proved them to be admirable employees, however, from the start. With a silent and reserved temperament and polite demeanor the natives have made a marked success as public service employees. They rarely become ruffled and their wonderful memory, lacking, it is true, in corresponding good judgment and originality, make them a marvel of exactness in the routine duties necessary in the running of a street railway. In the picking of employees special care is taken to secure only the healthy young Mongolians of the better educated classes. Owing to the large number of natives anxious to be connected with the new electric road the five hundred odd employees are the pick of a great number of applicants. After passing through mental examinations the recruits are taken before a Chinese doctor, of English training, and thoroughly examined; especially with regard to sight and hearing. The applicants are next drilled in the training room of the company located in the Hart Road car house. The training room is replete with maps of the tracks of the company, street names encountered in the different runs and a platform on which are mounted several motorman's controllers and brakes. The new men are taught to manipulate the dummy apparatus at signals given by the instructor and, the instructor always being the older and more experienced of the Mongolian motormen, and advice is freely given by the teacher in Chinese to his pupils.

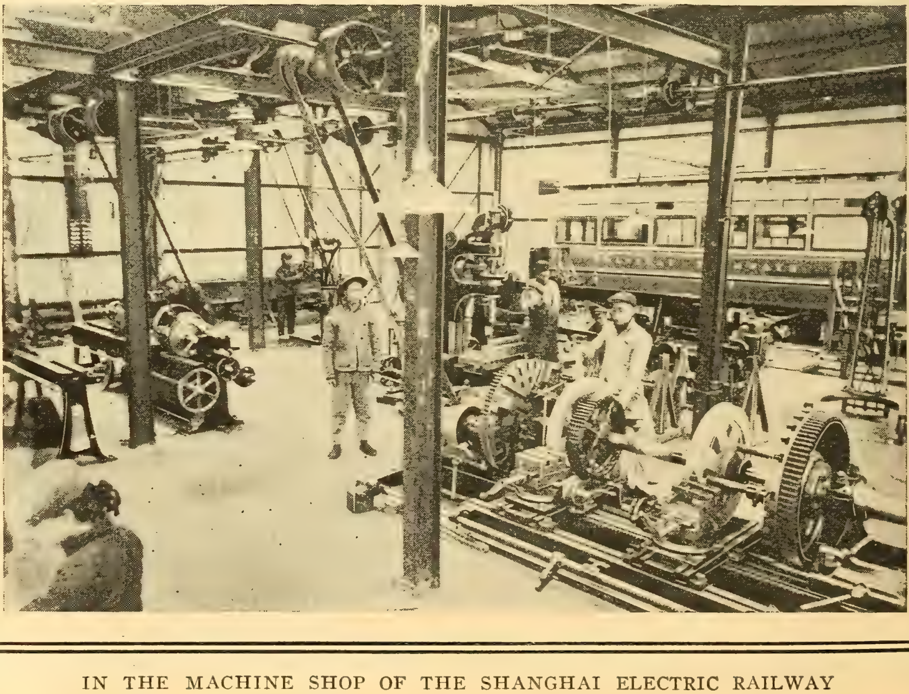
After the training with the dummy apparatus, applicants commence their real apprenticeship under the experienced men who run the cars. When they are deemed sufficiently educated in the practical side of the business a final examination is given and if a new man receives a passing grade in the examination he is given a certificate and put to work. The antiquated coinage still in use in China makes the conductor's job far from enviable. There are two classes of tickets to handle with four divisions in each class besides monthly and coupon season tickets and the coins with which cash fares are paid are what are called ten cash pieces, of which it takes approximately three to equal the value of our cent. For this reason it is



LEARNING TO OPERATE THE CONTROLLERS AND BRAKES



TURNING IN THE DAY'S RECEIPTS



IN THE MACHINE SHOP OF THE SHANGHAI ELECTRIC RAILWAY necessary for the conductors of the Shanghai system to collect several times the number of coins a railway employee in this country would have to handle. This is true notwithstanding the much lower passenger rates in force, and the weight in coinage which a Shanghai conductor carries on his last trip would floor many of our American railway employees.

The fare is governed by what is commonly known as the "zone system" and signs giving the fares in both English and Chinese are placed at the zone intersections. The cars are likewise labelled with signs giving the destination in the two languages by reason of the large number of foreigners living in the vicinity of Shanghai. A unique system of giving advice to the motorman is employed, each pole having painted on it in Chinese instructions regarding the use of current, same being based on the distance of the next stop and the grades encountered. A telephone system also allows for the prompt transmission of orders to all parts of the line, it being utilized as a dispatching medium for the regulation of traffic.

Perhaps in no single detail of the service as many difficulties have been successfully dealt with as in the matter of fare regulation. Complications of every kind, with which no other railway in existence has ever had to contend, made fare rates a matter requiring the utmost skill and patience to give adequate returns to the company. The competition of the native vehicle of China, a two-wheeled affair termed a "jinrikisha" made the fares low enough but in addition to this the depreciation of the subsidiary coinage in which fares are paid caused a still greater reduction in receipts which was not counterbalanced by the money paid out as expenses. Other forms of public service in China have not had to cope with this problem as their income was in the form of Mexican dollars, which are not subject to the depreciation that exists with the smaller currency.

Both the rolling stock and electrical equipment are of English manufacture, the standard car being a single truck, 9½ ton vehicle propelled by two 25-horse motors and the overhead trolley is used throughout the system. The company maintains a large repair shop, all of the work being performed by native employees, which turns out construction equipment and keeps the cars in running order. It is indeed a strange sight to witness Chinese workmen bending over fine machine work or a broken armature, skilfully making the needed alterations. There is something almost unbelievable, in this inconsistent linking of work requiring such a high degree of perfection and the slant-eyed oriental who slides around the shops in loose shoes and still looser garments. To the American who has never been able to associate the Chinese with other than an ironing board a trip through the Hart Road shops at Shanghai will be a source of great surprise and interest, resulting in greatly enhanced respect for the brain behind the yellow skin of the average native of China.

How Does a Cell "Recuperate"?

After your flashlight battery had run down and you had laid it aside you were no doubt surprised on trying it to find the lamp quite bright again. The battery had "come back"—but what had really happened? The cause of the rapid running down of some primary cells may be summed up in the word "polarization."

As the cell sends out current little bubbles of hydrogen gas collect on the surface of the positive electrode and hinder the contact of this plate with the liquid and also, like air, offer a resistance to the passage of current. By placing in the cell, some liquid or substance termed a "depolarizer" which will combine with the free hydrogen and take it up, polarization is much reduced. Sometimes, however, the cell is worked so hard that the hydrogen bubbles collect faster than the depolarizer can combine with them. Then it is that a short period of rest will make the cell come back if the chemicals themselves are not all used up. Black oxide of manganese and powdered carbon is the depolarizer in dry cells and nitric acid, copper sulphate, bichromate of potash, etc., is used in various wet cells. One cell, the Smee, removes the bubbles by mechanical means, a platinum-plated silver plate offering a roughened platinum surface from which the hydrogen bubbles easily free themselves and pass off.

The temporary tomb of Mary Baker Eddy, founder of Christian Science, is lighted with electricity, and is equipped with a telephone. A guard is stationed at the tomb, and watch is kept day and night. A large mausoleum is being built, in which Mrs. Eddy's body will be permanently placed.

"Live Batteries"

By WARREN H. MILLER

A study of the electric fishes goes far to convince one that all our nervous system is essentially electric, and this is true throughout the animal kingdom. No other medium is instantaneous enough to transmit the will of the mind to the muscles. By the electric current alone can you deprive anyone of the control of his own nerves, as witness the total disability of a person, holding the electrodes of a powerful Rhumkorff coil, to let go of them.

The electric pressure in the nerves is otherwise entirely under the control of the mind, and conversely the smallest irritation on the most outlying nerve is instantly telegraphed, not through the general body but along the particular nerve to its branch and down the branch to the main nerve leading to the brain.

THE GYMNOTUS ELECTRICUS OR SURINAM EEL

The electric batteries of the gymnotus,—the famous electric eel; of the numerous species of torpedo rays; of the electric catfish of the Nile; and of the queer elephant-nosed fishes of the Congo are all built on the same plan—the motor plate which terminates all nerve-ends in ordinary animals is enormously developed; thousands of these motor plates are assembled, all feeding by branches into a few large nerves; and the plates are insulated in series of thousands of cells, filled with a jelly-like fluid and formed out of ordinary muscle tissues into hexagonal or flat or longitudinal cells. Each plate has a ramification of nerve tissues on the back of it, and each is provided with a minute artery and a vein for maintenance.

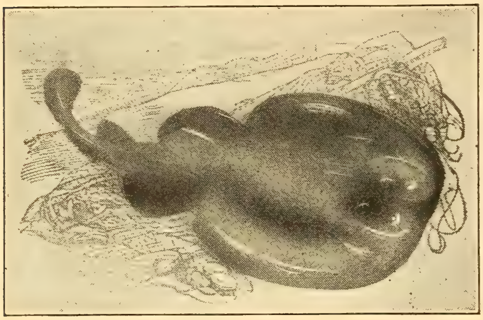
The action of the mind, if it so may be termed, of any of these fishes can induce a state of static pressure on the face of these plates, and can alter the strength of the electricity drawn from the battery at will. He can give you no shock at all, or a little one, or one so violent that you will be more than four hours getting back possession of your faculties in the stunned part. If you take a torpedo ray, used from long captivity in an aquarium to the presence of man, and stroke the fish lightly, he will pay no attention whatever. But draw your finger sharply down his back so as to irritate him and you at once invite a powerful shock; do it again, still more roughly his eyes will depress sharply and you will get such a stunning shock as to paralyze your arm for a day.

All of the electric fish are exceedingly pugnacious. Two Nile catfish, placed in the same tank will invariably fight until one is shocked to death. Reaumur, the celebrated French physicist, placed a duck in a tank in which he had a torpedo, and the fish killed it in a short time. The electric eels of the Orinoco, Surinam, and the Amazon tributaries are to this day a veritable pest to travellers who are obliged to ford some of these streams on horseback, as the eels instantly attack the horses and mules, which are lucky to get across alive. Baron von Humboldt's account of the methods of capture of the gymnotus by the Indians of the Orinoco, by exhausting their electric powers upon wild horses before attempting their capture, gives a vivid picture of their methods of attack. Says the great naturalist:

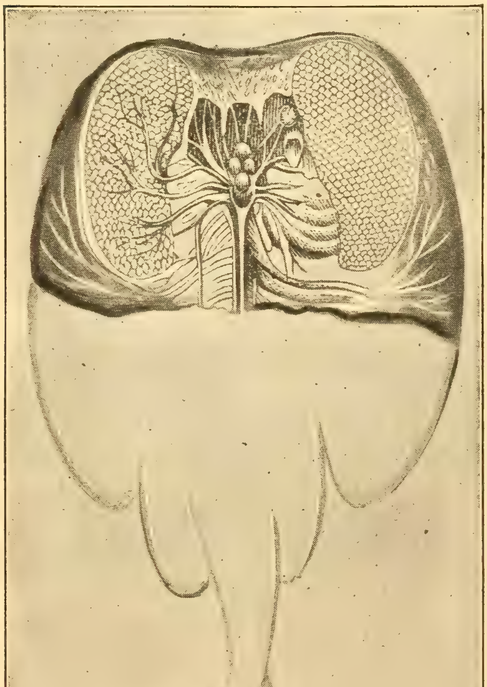
"I shall but imperfectly depict the intensely interesting spectacle presented to our view by the combat of eels against horses. The Indians, provided with long reeds and harpoons, placed themselves around the pool. They all prevented by their cries and the length of their rods the horses from attaining the shore. The eels, frightened and confused by the noise of the horses, defended themselves with their electric batteries. For a long time they seemed likely to gain a victory over the horses and mules: these were seen in every direction, stunned by the frequency and force of the electric shocks, to disappear under the waters. Some horses, however, in spite of the active vigilance of the Indians, gained the shore exhausted with fatigue, and, their limbs being benumbed by the electric commotions, they stretched themselves at full length on the ground. I could have wished that a skillful painter had had the opportunity of seizing the moment when the scene was most animated. The group of Indians surrounding the basin; the yellow and livid eels, which, like huge aquatic serpents are swimming on the surface of the water and pursuing their enemy; all these objects presented without doubt the most picturesque assemblage imaginable. In less than five minutes two horses were already drowned. The eel, more than five feet long, glides under the belly of the horse or mule; it then makes a discharge from the entire extent of its electric organ. It attacks at once the heart, the viscera and particularly the plexus and the gastric nerves. It is not therefore, surprising that the effect it produces upon a large quadruped should exceed that produced in a man, whom it touches at only one of his extremities. I have my doubts, however, whether the gymnotus kills the horses immediately. I rather believe that the latter, stunned by the reiteration of the electric shocks, fall into a profound lethargy. Deprived of all sensibility they disappear under the water, the other horses and mules pass over the bodies, and they perish after a few minutes.

"After this commencement I was afraid that the sport might terminate very tragically: I did not doubt but that by degrees the greater part of the mules would be drowned. But the Indians assured me that the fishing would soon be over and that nothing is to be dreaded but the first assault of the gymnotus. In fact, whether the galvanic electricity is accumulated in repose, or the electric organ ceases to perform its functions when fatigued by long use, the eels after a certain time resemble discharged batteries. The muscular action is still equally active but they no longer have the power of giving energetic shocks. When the combat had lasted a quarter of an hour the mules and horses appeared less frightened; they no longer bristled at the mane, and the eye was less expressive of suffering and fear. They no longer seemed to fall backwards; and the eels, swimming with the body half out of water and now flying from the horses instead of attacking them, began themselves in their turn to approach the shore."

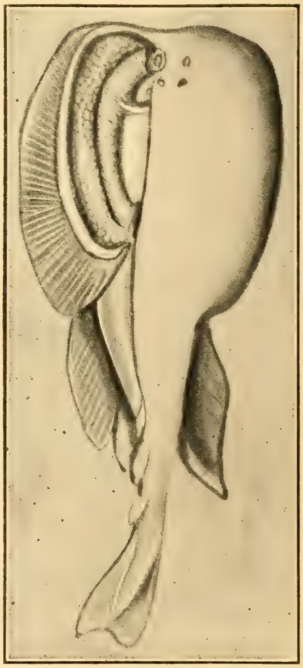
All the electric fishes require rest and food after giving repeated shocks when their batteries become exhausted—another proof of the action being a mental and nervous phenomenon. A dead or nearly dead one will give no shock, and the feebler and in poorer health the animal is, the weaker shock it can give. In a strong, live animal, if the nerve leading to the cells is cut, it can give no shock, but, if the stump of the nerve on the battery end be irritated, the full force of the battery will be discharged. This fact seems to point out that the battery is not galvanic, as the early naturalists of the Eighteenth Century were inclined to think, but rather, static, as the most powerful charge it could produce was *lodged* on all the motor plates in the battery during the anguish of cutting the nerve, (with insulated scissors, of course) and this discharge took place at once on further irritating the nerve. There is nothing like this mental formation of a powerful destructive force in the whole animal kingdom, unless it might be the spontaneous formation of venom in ordinary saliva under mental stress of intense anger. The venom of snakes is simply a modified form of saliva, secreted in the same way, and the facilities of producing and storing it have probably developed in the venomous snakes through centuries of evolution. It is their sole means of defense against large and predatory animals. Dr. Shufeldt, the well-known authority on snake venoms, says: "I would rather be bitten by any number of Gila 'Monsters' than by one person in a raging, mad state of anger." The venom formed of ordinary saliva under such terrific mental and nervous stress is at all times highly dangerous to the blood, and may have been a primitive means of defense in our remote ancestors. In the same way Nature has developed the feeble electric properties of the ordinary nerve system into a static battery of force enough to enable all the electric fish species to attack and kill their prey, and to defend themselves against enemies larger than themselves. Cuvier states that the electric eels can stun and kill fish fifteen feet off, and, you will note from Baron von Humboldt's narrative, that the eels shocked the unfortunate horses through the lungs and heart by gliding under and around them. Reaumur's duck was also killed by the torpedo without the creature ever leaving the bottom, while the duck floated paralyzed above him. These facts are food for highly interesting reflection. There is no doubt as to the shock being a high tension static discharge, as Hunter obtained sparks by insulating a metal gap in a circuit shocked by a powerful electric eel; and Galvani, Walsh, Pringle and Magellan all obtained sparks from the gymnotus, torpedo and Nile cat. No galvanic current has sufficient tension to bridge such an air gap, as it takes a pressure of 10,000 volts to jump one-fourth inch with ordinary direct-current form of dynamo. Yet to store any appreciable charge of static electricity at high tension requires the driest of apparatus and clear, dry weather for the static machine to operate. Notwithstanding this, the gymnotus attacks its prey from considerable distances and has been known to stun and drown swimming Indians, frequently at distances from four to six feet. How does he raise this high tension in the midst of a good conductor like water, when we can hardly do it in dry air? And how can he direct it at his victim through the surrounding water, when we know that electricity always takes the shortest path through a conductor from positive to negative?



THE TORPEDO FISH OF THE MEDITERRANEAN



ELECTRIC APPARATUS OF THE TORPEDO



TOP VIEW OF THE TORPEDO FISH

How he generates it is evidently by nervous action. The battery of the gymnotus consists of four long bundles of plates occupying about one-third of the bulk of the fish. These plates are long, thin nerve motor-plates, separated about 1-20th of an inch apart, running parallel down the body from head to tail, and set vertically on edge. Cross plates divide it into numerous cells, filled with a clear jelly-like fluid. Ramifications of nerves spread over the entire surfaces of the plates. About 240 plates make up a battery for a full-grown six-foot eel, giving a surface of 123 square feet of plate. The head end of the eel is positive and tail negative. His thick, olive green body is covered with minute pores, which continually exude a gluey, viscous fluid in such quantities that the water of the troughs in which specimens are kept for exhibit by the Surinam Indians, has to be changed every day.

The battery of the torpedo ray consists of perpendicular hexagonal prisms, extending from the top to the underside of the ray, being longer or shorter according to their position in the body. The plates are placed one above the other, 150 to the inch in the prisms, and are very vascular, having each a vein and an artery besides its own particular nerve.

The total surface of plates in a large torpedo is 58 square feet. When we realize what a very powerful shock a Leyden jar of only a few square feet capacity can give, it is easy to understand the terrific force of these live batteries. Baron von Humboldt's experiment of placing both his feet upon a gymnotus resulted in a shock infinitely more severe than the heaviest he had ever felt from the most powerful Leyden jar. He was laid up with violent pains in his knees and more or less distress throughout his entire body, for the rest of the day. Indians struck by the shock are deprived of the use of their limbs for not less than 20 minutes, and hence are drowned if attacked by the eels, while swimming.

The ability to strike through any space of water is not at all clear, with our present knowledge of static electricity. It may be classed with the phenomenon that 27 persons joining hands are all struck with equal severity under a static electric shock or by an eel or torpedo, whereas, with ordinary low-tension dynamic electricity, the greater the resistance the feebler the effects. The electric shock itself owes its disagreeable commotion in our nerves principally to the highly oscillatory nature of the discharge, whence the passage of such a current will affect all equally. A similar action is probably felt when these fishes loosen their static charge in the water. Everything in the water within range of the disturbance feels it equally. The torpedo is positive on his upper surface and negative on his lower, so that the whole bottom of the sea is "ground" to him, and his shock must traverse everything around him in arriving at ground. The eel is positive at his head and negative at his tail, whence his habit of bowing himself around the victim if possible in order to make his shock the more effective. The Nile cat is positive on one flank and negative on the other, wherefore his best method of attack would be above or below his enemy.

In all cases, equilibrium is restored by the oscillatory static discharge through the water to the other pole, and the amount of water actually affected depends upon the severity of the shock. If one happens to be in the zone, the shock is felt without requiring to be in an insulated circuit, as with dynamic electricity. On land a similar effect is noticed as it is not necessary for a chain of people to be insulated from the ground to feel a shock imparted to the first and last member. With a flowing dynamic current the circuit would only be felt at the finger tips of the first and last person, as the ground offers a better conductor than the chain of persons.

As to the method of loosing the shock, it is quite probable that the gymnotus closes his skin-pores, thus insulating himself in his viscous covering, just previously to awakening the electric pressure in his batteries. Opening the pores would then at once open an outlet to restore the static equilibrium through the water. As for the torpedo, no such provision is made, and the only physical movement observable is a depression of the eyes just previous to the delivery of a shock. This may indicate a sudden awakening of the static pressure through nervous action or possibly some internal method, so far not discoverable by dissection, by which the static discharge is loosed after the desired pressure has been produced.

In conclusion it may be stated that these phenomena are all the effects of releasing a static charge induced by the animal's nerves on the plates of the battery. While dynamic and static electricity are one and the same thing, the first is a flowing current and hence must follow the laws of conductors, and would be much harder to handle in such a wild environment as the weapon of a carnivorous fish. The static charge, however, simply requires means for its production, release, and discharge, and is undoubtedly the method that Nature has taken to make a weapon out of that mysterious animal electricity by which we all "live, move, and have our being."

Electric Block Signaling

By SIMON DEUTSCH, E. E

PART III.

On Aug. 20, 1872, the United States Government issued to William Robinson, Patent No. 130661, covering a means of energizing or controlling, through the medium of the two track rails of a railroad, an electro-magnet, located at a considerable distance from a feeble source of power.

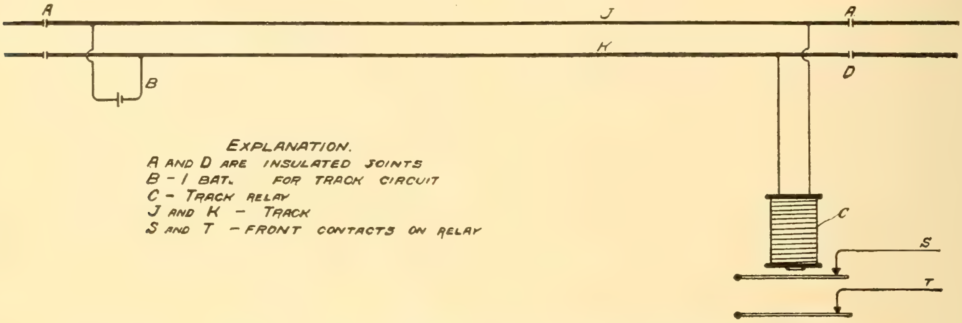

A
J
A
K
D
B
EXPLANATION.
A AND D ARE INSULATED JOINTS
B - 1 BAT. FOR TRACK CIRCUIT
C - TRACK RELAY
J AND K - TRACK
S AND T - FRONT CONTACTS ON RELAY
C
S
T

FIG. 6. MOST COMMON FORM OF TRACK CIRCUIT

This simple invention, technically termed a "closed track circuit," in itself merely involves a practical and economical method of transmitting current, from a proper battery, through the two running rails, of such strength as properly to energize an electro-magnet also electrically connected to the two rails, and the entire arrangement forming a continuous circuit.

To any system of automatic block signaling, where the signal indications are controlled by the position of a train on the track rails, condition of the track, switches, derails, etc., this simple invention of a closed track circuit is basic and indispensable.

The term "track circuit" as used in signal work, designates an electric circuit using the rails, on which trains operate, as electrical conductors to carry the current from a battery or other source of power, to an electrical instrument, usually a form of electro-magnet carrying contacts controlling other circuits, as shown by Fig. 6. The presence of the wheels of a train or car on this track is indicated by its effect, electrically, on the conductor-rails and the electro-magnet, which in turn communicates itself to the signal or signals controlled by contacts on the electro-magnet.

A form of electro-magnet described above and properly termed a "relay" is shown by Fig. 7. The track circuit most commonly used, as shown in Fig. 6, consists of (A) the "insulating joints," shown by Fig. 8, used for electrically separating one section of track from another; (B) the track batteries in a battery chute, shown by Fig. 9, generally placed at the extreme end of the circuit, and (C) the relay, placed at the extreme other end of the circuit. To insure a continuous circuit of low resistance, heavy iron wire is used to bond around the rail joints within the circuit, shown by Fig. 10.

With a system of this kind, it is apparent that any disturbances in the circuit, due to failure of battery, short circuit, broken rail, open switch or derail, is immediately evidenced by the position of the signal blade, which is arranged to assume the "stop" position upon failure of current supply.

Up to the year of 1884, practically nothing had been done in the way of automatic block signaling. Some trial block signal and interlocking installations were made in this country between 1873 and 1880 which were examined with much interest and appreciation by many railroad officials. Partly as a result of this interest in signaling devices, a group of capitalists organized a company in 1882, for the purpose of exploiting the Robinson and other signal inventions.

In 1884, this company made the first large installation of automatic block signals controlled by track circuits. However, in view

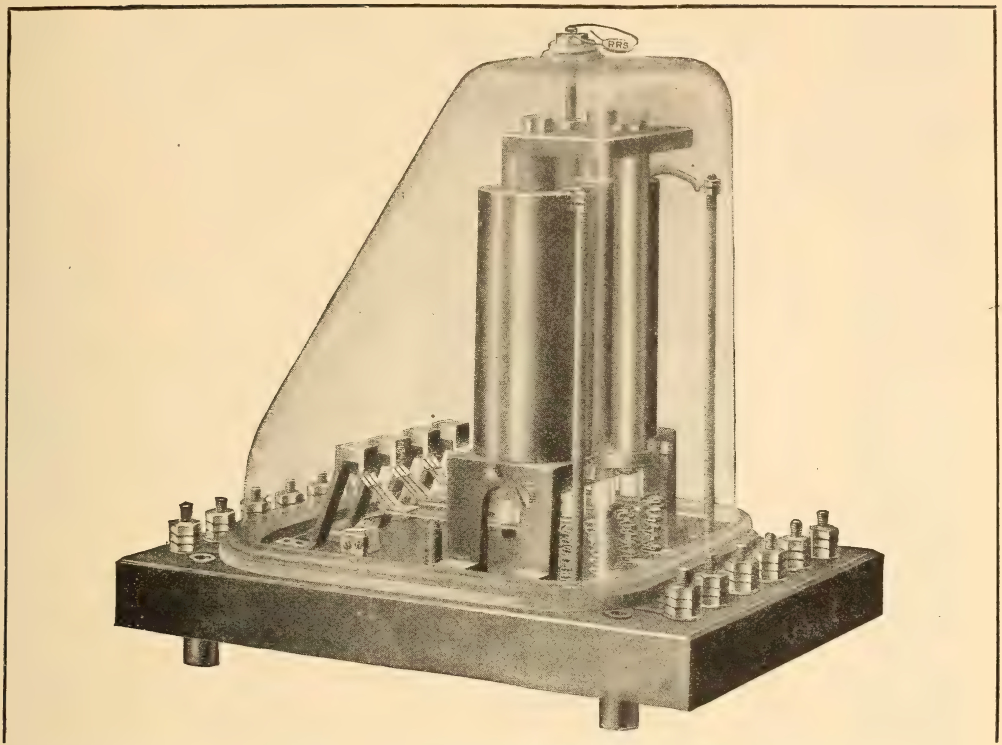


FIG. 7. COMMON FORM OF "RELAY" USED IN ELECTRIC BLOCK SIGNALING

of the fact that this company owned and controlled the Robinson patent which was basic and necessary to any practical system of automatic signaling, competition was lacking, with the result that up to the expiration of this patent, Aug. 20, 1889, only a total of 920 automatic signals had been installed.

Although during the seventeen years of life of this patent it had been so little used, most of the important principles now employed in automatic signaling, were known years before the expiration of this patent, and a great many valuable contingent ideas were developed and patented, such as the "overlap," "polarized track circuit," etc., of which mention will be made later.

It was therefore not until about 1892 that more popular interest was directed to this art, and under the stimulus of competition, improvements were made in all details which heretofore had been more theoretical than practical. Everything from the signal mechanism down to the bonding wires received careful study and attention with the view of improving them, and, in general, underwent a change for the better. The railways, quick to appreciate this advancement to a practical stage, began to install these systems on their busiest lines, and by the end of 1899, there were about 6,500 automatic signals in use, of clock-work disk,

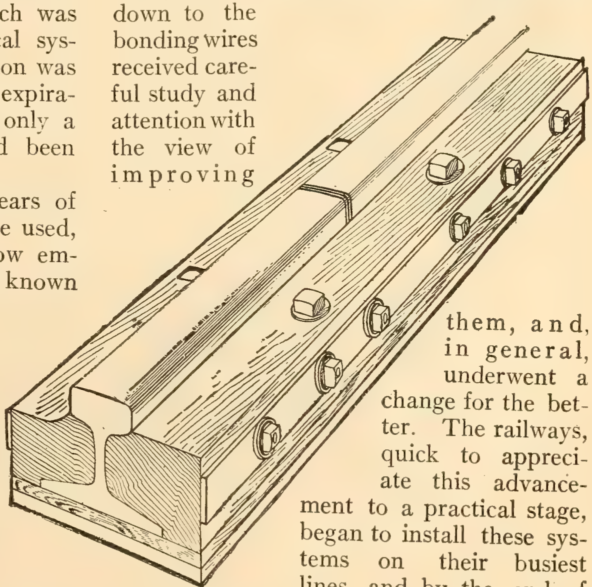


FIG. 8. SHOWING HOW TRACK JOINTS ARE INSULATED

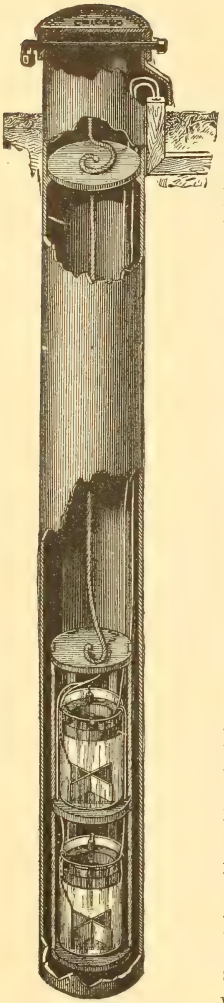


FIG. 9. BATTERY CHUTE

enclosed disk, electro-pneumatic semaphore and electric semaphore types. Five years later there were over 20,000 automatic signals in service.

This brings us to 1905, and it is practically between this year and the present that the most rapid strides have been made, both as regards the development of the apparatus and number of installations made.

In installations there has been a decided decrease in the number of clock-work disk-signals used, but few enclosed disk signals, electro-pneumatic and electro-gas signals, and enormous increases in the number of electric semaphore signals. In fact this latter type has almost entirely supplanted all other types, more having been installed in the last five years than were installed of all other kinds in the past thirty years.

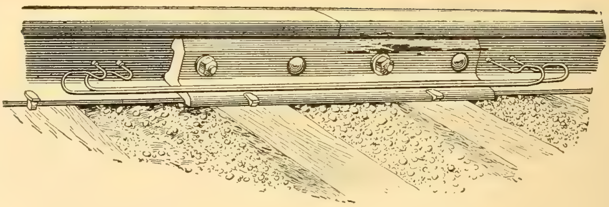


FIG. 10. BONDED RAIL JOINT

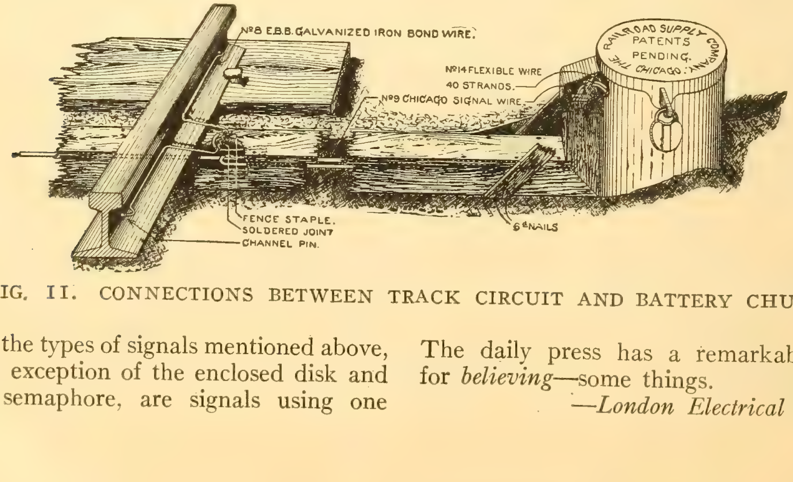

Nº8 E.B.B. GALVANIZED IRON BOND WIRE.
Nº14 FLEXIBLE WIRE 40 STRANDS.
Nº9 CHICAGO SIGNAL WIRE.
THE RAILROAD SUPPLY COMPANY CHICAGO
PATENTS PENDING.
FENCE STAPLE.
SOLDERED JOINT
CHANNEL PIN.
6d NAILS

FIG. 11. CONNECTIONS BETWEEN TRACK CIRCUIT AND BATTERY CHUTE

All of the types of signals mentioned above, with the exception of the enclosed disk and electric semaphore, are signals using one kind of power for their operation, and another kind of power for their control, as their names indicate. Experience has proven the "all electric" or "one power" type of signal to be the most efficient, flexible, and economical in operation, and engineers for signal companies and railroads have directed their energies during the past few years towards the simplification of these types.

(To be Continued.)

Same Story Over There

In reporting a fire at a Wellingborough (England) music hall, a provincial paper concludes thus: "Though it cannot actually be stated as a fact, it is believed the outbreak was due to the fusion of an electric wire." Of course it is—what else *could* be the cause? As, to the reporter's mind, all brides are charming, all bridegrooms handsome, so all fires are electrical—when there is no evidence as to the real cause.

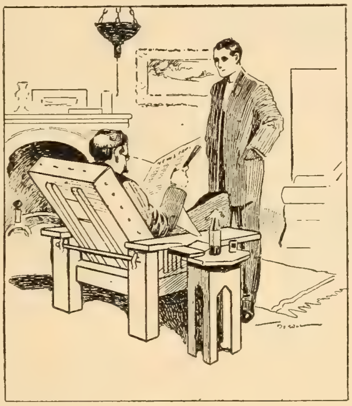
We do not question for a moment that all gas explosions are "alarming," for really they do give you a shock, you know. A Glasgow paper, however, says that one of these "alarming" events that occurred in that city last Friday, "*is believed* to have been caused through a defective electric light fitting. . . . melting a gas supply pipe." The daily press has a remarkable ability for *believing*—some things.

—*London Electrical Review.*

Talks With the Judge

THE MAKING OF LIGHT

"Those things which are apparently most simple are sometimes hard to explain in every-day English," said the Judge, "I am generally there with an explanation of some kind whenever a question is asked me, and, by long practice in the art of conversational gymnastics, I can almost always get away with it by talking fast and mumbling a word here and there. Now just yesterday a fellow came to me with the question: 'How does electricity make an incandescent lamp burn?' When he sprung it, I stooped for a moment to tie my shoe and when I straightened up I said: 'It is caused by the intermolecular resistance of the carbon particles under the stress of voltaic forces actuated by the dynamic power of the dynamo.' I got it off without batting an eye and he said, 'Oh yes, to be sure I remember now, it was in Carhart's physics, wasn't it?' Then I steered him around onto the subject of the different books we studied when we used to go to school."



How does electricity make a lamp burn?

"Well, Judge, what more do you want? You told him, didn't you?"

"Yes, I know, but perhaps it was not a very clear explanation. I would like you to tell me so I understand it myself."

"All right, then," I replied, "for a simple explanation imagine this: A broad, deep, placid stream of water flowing leisurely along between its banks; that corresponds to the heavy feed wire from the power station carrying a large amount of current but carrying it easily, for the wire is plenty large enough and the current from the dynamo flows over it easily.

"Now all of a sudden this stream comes to a narrow gorge with a very small cross section. The high banks all along the stream demand that all the water shall go through the gorge. The only way the result can be accomplished is for the water to travel faster, and consequently it goes raging and tearing through, spending a vast amount of energy in straining and lashing at the rocky walls.

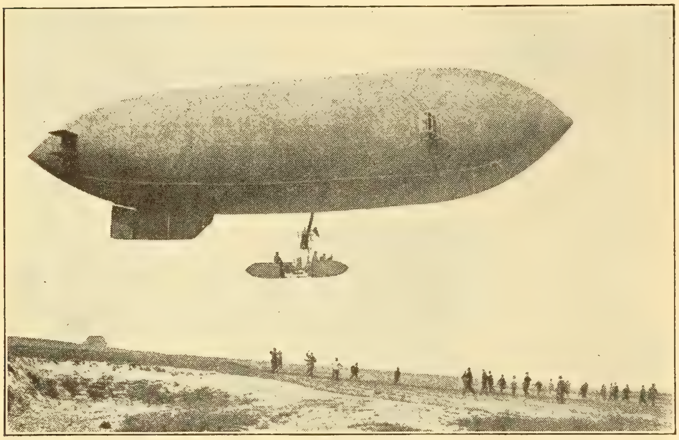
"In the circuit of the electric current you have an analogous case when you insert the fine, hair-like filament of an incandescent lamp as you do when you turn on the lamp. The filament then becomes the narrow gorge in the electric circuit and places a restriction on the flow of current. But there is a big pressure back of it and the current is forced through the high resistance of the filament at a tremendous rate and we have a phenomenon similar to friction; that is, energy is dissipated at the point of resistance in the form of heat and as a consequence the filament is brought to a very high temperature, causing it to glow.

"This brings up an interesting point in connection with the comparatively new tungsten lamp which is so rapidly displacing the old carbon filament type. In the latter type of lamp the filament is composed of specially treated carbon. This carbon could be heated up to a clear white heat, if desired, and consequently give much more light. But it has been found that the carbon will vaporize or disintegrate rapidly above a certain temperature and soon coat the interior of the globe with a dark deposit, quickly making the lamp useless. Therefore, carbon filament lamps are designed to operate at a temperature which gives the light a distinctly yellowish tinge.

"In casting about for better filament material, after years of experiment, the metal tungsten was hit upon. Tungsten will not vaporize to an appreciable extent even up to its melting point. Consequently tungsten lamps may be operated at a temperature many hundreds of degrees above that of carbon lamps and the terrific temperature raises the filament to a perfectly white heat and the light for a given consumption of current is much more powerful.

Does Lightning Endanger Dirigible Balloons?

Ever since Benjamin Franklin made his historic kite experiment it has been generally acknowledged that a metallic connection with an object high above the earth would facilitate the discharge of any potential gathered in the clouds. If the lower terminus of the wire or cable were insulated from the earth, as in the case of the captive balloons used by those who have experimented with the electrical stimulation of plant growth, there would be a discharge from the same to the earth through the air. Ordinarily this would be at a very moderate rate, but if the charge reached a high value it might lead to that sudden breaking down of the air gap which we call lightning. However, if the lower end of the metal cable which leads to the flying kite or balloon is itself grounded any differences in the electrostatic charges of earth and clouds will continually neutralize themselves through this cable. Hence in a balloon dragging a metallic cable which dips into the water as was the case with Wellman's America, this cable constitutes an effective lightning rod, and as it was connected metallically to various parts of the balloon's covering, Wellman had nothing to fear from atmospheric electricity.



DIRIGIBLE BALLOON "CLOUTH" WITH WIRE-SUSPENDED BASKET

But how about the dirigibles which strike out boldly above the earth, those which are not, as it were, tied to earth's apron strings? Take for instance a modern German dirigible such as the "Clouth" which is 135 feet long, with a maximum diameter of 27 feet and which has stabilizing fins and rudders made out of aluminum tubes covered with cotton, thus offering additional metallic points projecting into the charged air. In this case the car which carries two passengers besides the pilot and the engineer, has a frame work of steel, thus again introducing the metal elements with the danger to the passengers as well as the balloon modified according as steel or hemp ropes are used for suspending the car.

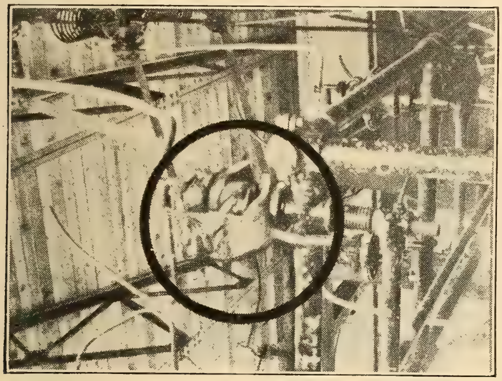
Even greater is this danger with the much larger dirigibles operated by the Zeppelin Company, in which the inner aluminum frame work allows of a surface charge amounting to over a thousand volts per yard of length, so that a balloon fully a hundred yards long may accumulate a difference of over 100,000 volts between its extreme ends. Should this tend to neutralize itself by puncturing the enclosure at any point, it might easily set fire to the gas filling and explode the balloon. To avoid such a mishap it was at first suggested that all metallic parts be carefully rounded so as not to present points from which a discharge could take place. This has not been practical, so the alternative has been that of providing the exterior with a protective network of metallic conductors connected to the interior metal frame work at places where the discharge cannot set fire to the gas.

Some Uses of Hydrogen

A generation ago hydrogen was little more than a curiosity found in the chemist's laboratory. One of its earliest uses—being the lightest substance yet known—was for filling balloons. It now takes part in the preparation of tungsten electric lamp filaments. In the last mentioned industry the metal is combined with carbon, and then to remove the carbon the unfinished filament is immersed in a hydrogen bath. The gas gradually unites with the carbon and so leaves the tungsten pure.

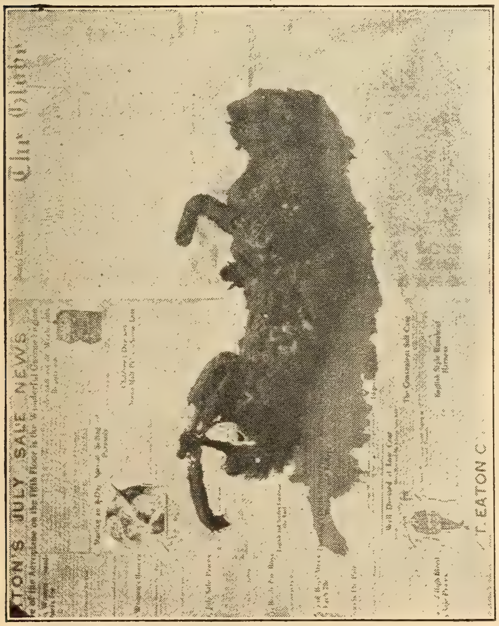
Two Interesting Electrocutions

Any animal which scampers about among the high tension conductors in a power plant gambles with death. Sooner or later its life is snuffed out and likely as not at the same time a generator of several thousand horsepower may be temporarily shut down as a result of its innocent amusements.



THIS RAT HAD BEEN STUDYING ELECTRICITY

The first picture shows the remains of a mountain rat which was studying electricity in the plant of the Telluride Power Company. While pursuing its investigations it accidentally "shorted" the high tension side of a lightning arrester onto the supporting frame. This caused a large arc to start making it necessary to pull one of the generators off the line. After it was all over the rat was so near the color of the surrounding objects that it didn't even take a good photograph. Puzzle—Who can find the rat inside the black circle?



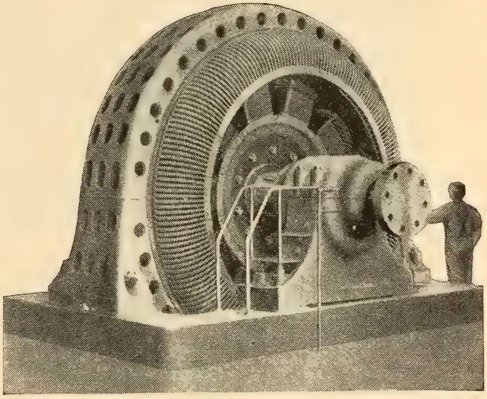
REMAINS OF AN ELECTROCUTED CAT

The second picture shows some cat fragments after the animal had received a charge of 12,700 volts to ground, in the central station lighting plant in Toronto, Ontario. The cat had thought to find mice among the bus bars at the back of the switchboard. Can anyone maintain after this example that electric cooking is not practicable?

A Mighty Generator for Niagara Falls

Comparing this great dynamo with the man who stands beside it will give the reader an idea of the size of a machine capable of developing 6,500 K. W. or approximately 8,700 horsepower.

This is one of six Allis-Chalmers alternators which will go in the plant of the Cliff Electrical Distribtuing Company of Niagara Falls, N. Y. These dynamos are operated by hydraulic turbines and develop current at 12,000 volts. They are designed to run at 300 revolutions per minute but the governor went wrong on one of them and it stood up under a speed of 525 revolutions, which shows that a high factor of safety was allowed in the design of the machines.



GENERATOR OF 8,700 HORSEPOWER

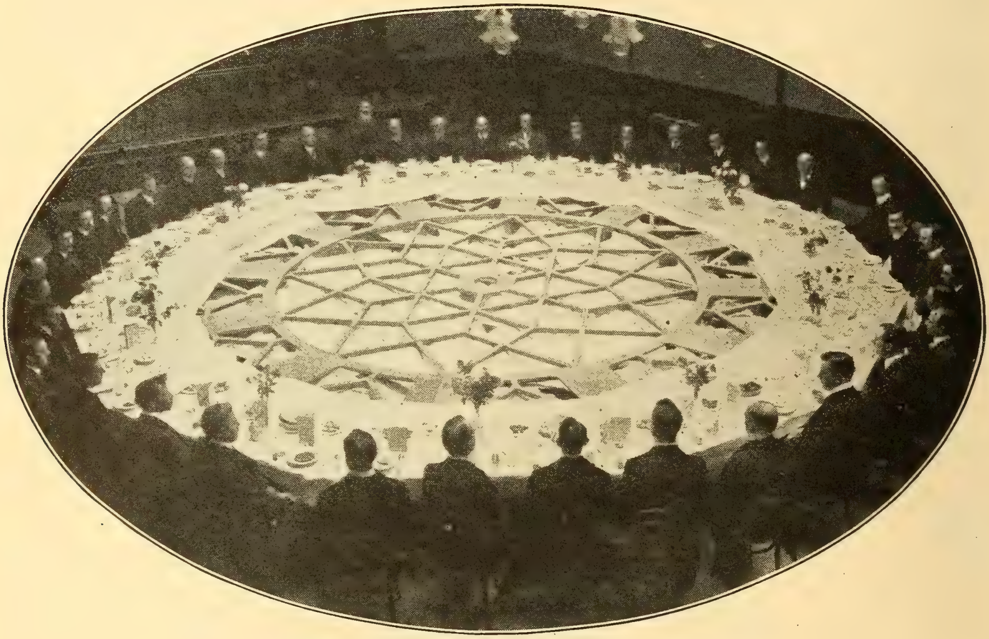
A Remarkable Clock

One of the largest electrical clocks in the world is located in the tower of the Liverpool Royal Society Building, England. Four dials each 25 feet in diameter mark the time with huge hands, the minute hands being fourteen feet long and three feet at the point of greatest width. Owing to their exposed position the hands and clock face were built to stand a heavy wind pressure.

The dials of this enormous clock are electrically lighted and by automatic apparatus the electric current is switched on the lighting circuits at dusk and disconnected at dawn, the time of lighting up changing with the seasons, being from 4:20 P. M. in the winter to 10 P. M. in the summer, with proper variations from time to time.

The electric transmitter of the clock is connected with Greenwich, thus assuring correct time. One feature which few people detect is the absence trom the dial of the Roman letters, their places being occupied by plain black rectangles. In building the clock the dial was constructed and put in place in twelve sections, each section being that portion marked off for five minutes of time and weighing 550 pounds.

The accompanying illustration shows a unique banquet table at a luncheon held in the Free Trades Hall at Leicester in celebration of the completion of this remarkable time piece. At this feast a company of 50 people sat down around the reproduction of the face of this clock declaring it to be something new in the way of "time" tables.



SOMETHING NEW IN THE WAY OF TIME TABLES

Telephoning from An Automobile

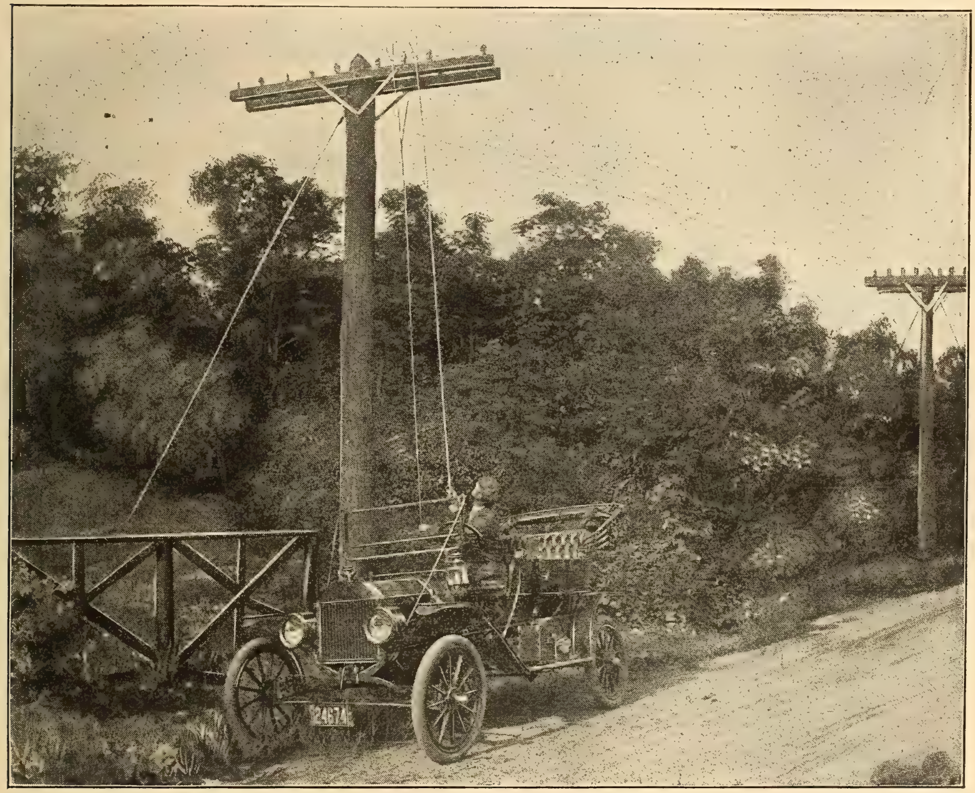
By Frank C. Perkins

Manager C. Durr Forrest of the Independent telephone system at Pomeroy, Ohio, has devised an ingenious telephone equipment for the use of automobilists. By means of this novel outfit the owner of an automobile can have telephone communication from any point in the rural districts where there are overhead telephone wires available. He can make connection with a telephone exchange within two minutes without leaving his seat in the automobile and talk with his home, business place or any city over a local or long-distance line.

It is stated that the conversation can be transmitted with the same degree of efficiency as any regular long-distance telephone and the many advantages of having the auto-phone available on a motor car are obvious. Every one who drives a motor car has seen the time when a telephone would have been a convenient article to have in the car, as in case of accident a garage, physician's office or other stations may be called up without even leaving the machine.

In addition to the telephone instrument, a pair of connecting wires are provided for conducting the current from the overhead wires, a jointed aluminum rod being employed for attaching the conductors without leaving the motor car. When the auto phone is ready for operation the rod is taken down and stored away as it is not required in detaching the wire. The detachable contact clip is so arranged mechanically that it will make a positive contact even with rusty wires and at the same time will not damage the finest copper wire and can be detached without any strain on the connecting cord.

It is stated that connections can be made in the dark if necessary as provision is made for finding the wire without having even to look up for it.



TELEPHONING FROM AN AUTOMOBILE

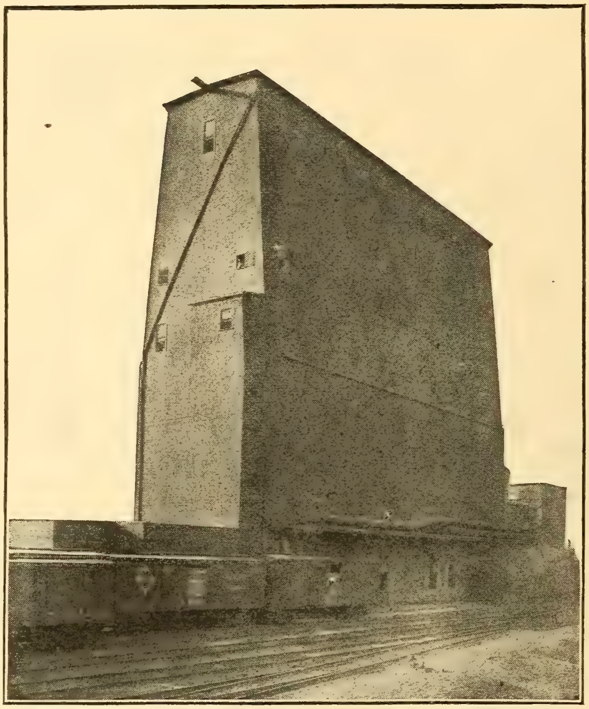
The Interurban Brings Country to City

This is essentially the age of electricity—the electric age—golden with its possibilities for men. The possibility of human happiness and development is given its exemplification in the "trolley car." Wherever the interurban goes it revolutionizes things. It has opened up a new life to man. It has placed the man in the business office in close communion with nature. It has broadened the areas of our great cities, relieved congestion in our centers of population by extending the residence sections, making it possible for both rich and poor to live in close communion with Nature the year round. In God's great out-of-doors, always under the dome of heaven, in the arena of the unconfined horizon, has man been able to work and play at his best, and the trolley car has served a great purpose in assisting man to get back to his natural environments.

Electricity in the World's Granaries

The first step in the preparation of a loaf of bread after the wheat leaves the immense grain fields of the West and Northwest takes place in the grain elevators where the wheat is cleaned, dried, graded and stored, or loaded on boats or cars for shipment to distant climes and ports.

The millions of bushels of grain raised every year require hundreds of elevators, large and small, located at convenient shipping points and equipped with modern machinery for handling the grain without touching it with human hands. The need for more or less automatic machinery is better realized when we know the capacity of some of these immense granaries. The largest one in the world is located at Fort William at the head of the Great Lakes and has a storage capacity of 4,000,000 bushels of grain. Some idea of the size of the Fort William elevator may be had by comparison with the one in the accompanying picture which latter has a capacity of 100,000 bushels or one-fortieth that of the former.


ELEVATOR WITH A CAPACITY OF 100,000 BUSHELS

Those who have lived on the farm and have followed the threshing machine about the neighborhood know how much dust is raised as the grain is threshed. The grain elevator, too, is a dusty place and great care has to be taken as to fire. Oil lanterns are used to some extent for lighting, but the more modern elevators are equipped with incandescent lamps in double glass or vapor-tight globes, while the extension cord and wire guarded lamp replace the lantern.

With dust constantly settling on everything, the direct-current open motor is an unsatisfactory means of power, for it produces more or less sparks at the commutator, but the entrance of the brushless, alternating current, induction type of motor makes electricity the safest, most convenient and economical of motive powers.

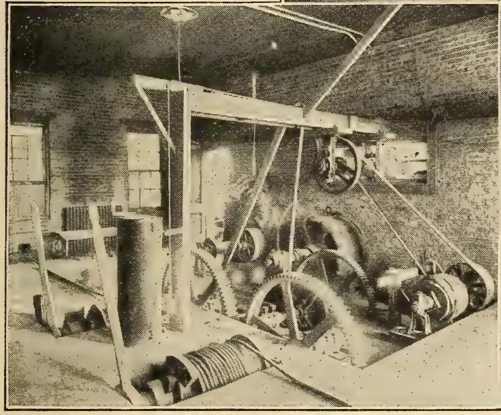
The elevator here shown is run entirely by electric power, and the large metal pipes which you see above the roof of the unloading platform draw the dust by suction out of the cleaning machines in the elevator and convey it to the dust house. The cars on the track contain grain which is to be taken into the elevator. At this end of the building is located the motor-driven "car-puller". A rope running over pulleys is drawn down the track, hooked to the cars, the motor thus pulling them up alongside the elevator. Another motor operates a long "shovel-shaft" to which are attached ropes, pulleys and big wooden shovels for unloading the waiting cars.

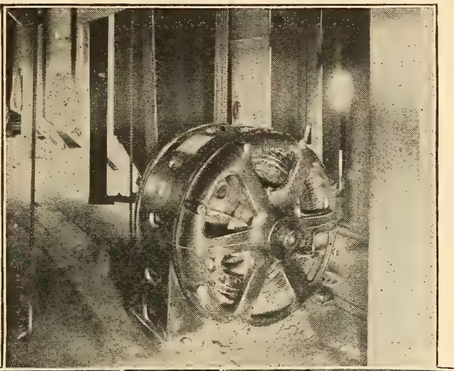
After the grain is unloaded heavy belts carrying metal buckets and running in wooden shafts or "legs", lift it to the top of the elevator by motor power to there begin its preparation for storage or shipment.

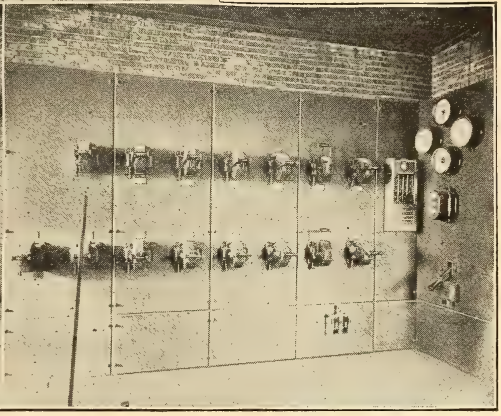
The switchboard is in a room cut off from the elevator. Pushing a button at any motor throws the annunciator on the switchboard, indicating to the attendant which motor is wanted in service. A return push button rings a bell at the motor showing that the attendant at the board is about to start the motor signaled for. Pushing a second button at the motor stops it.

Welsbach Electric Lights

If there is any name by which those interested in gas lighting can conjure, it is that of Dr. Carl Auer von Welsbach, the Austrian chemist who has reflected so much credit on his former teacher at Heidelberg, Professor Bunsen. For it was Welsbach more than any one else who raised gas lighting out of its old ruts over 20 years ago and enabled it to survive the competition of electric lighting in so many places. When the perfection of the incandescent lamp made it possible to use electric lights in residences the gas companies knew that they were face to face with their first real competition, and while they would not openly admit it, the fall in the price of gas stocks spoke louder than words. Many of the larger stockholders themselves were shrewd enough to invest also in the stock of electric light companies, while others counted on getting their returns while the economical distribution and use of electric lights was passing through the inevitable experimental years. By the time these years were about over, some of the gas interests had good reason for feeling uneasy, as the incandescent lights offered too many advantages to be offset even by a reduction in the rate for gas which would shave the profit to a questionable margin.


CAR PULLER


MOTOR DRIVE AT THE TOP OF AN ELEVATOR "LEG"


SIGNALING DEVICES AND SWITCHES

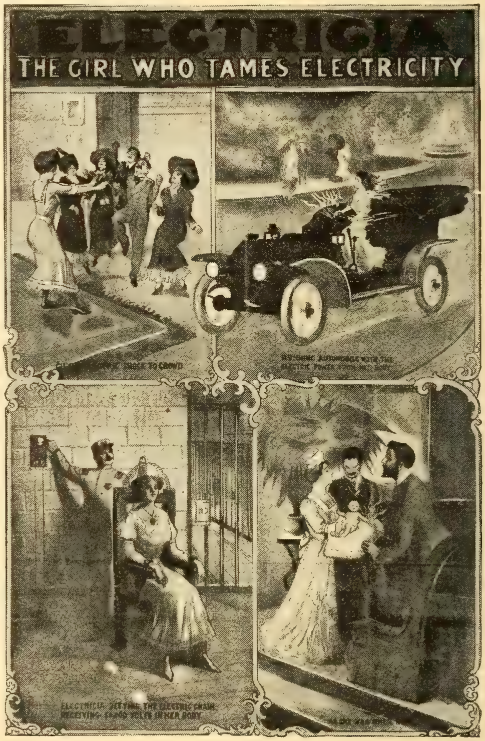
At this critical point Welsbach saved the day by his invention of a successful incandescent gas mantle which would enable the gas companies to compete with incandescent lighting while still charging a good rate for the gas. After years of careful experimenting Dr. Welsbach (who in Europe is always referred to as Dr. Auer) had found just the combination of rare earths that was needed to afford light-giving properties to a mantle when heated by a non-luminous gas flame. As this meant a more efficient use of the gas the producers only needed to make part of their proposed price reduction to stay in the race, and thanks to the thorough work of Welsbach and his business associates they were able to continue the struggle. For with all the disadvantages of the gas lamps which blacken walls and ceilings, consume the oxygen and vitiate the air of the rooms, the fact remains that they might have a price advantage over the old carbon filament incandescent lamps and there are always those who judge more by the cost than by the results obtained.

However the same helpful turn which came to gas lighting in 1891 through Welsbach's invention, came to the incandescent lamp a few years ago when tungsten was proven to be a practical successor to the carbon of the old filaments at nearly thrice its efficiency. This robbed the gas mantle lamps of their only real advantage, leaving their disadvantages to stand out all the more strongly and speeding the rate at which the gas lamps are being displaced by electric lights. How rapidly this change is going on, most of our readers will know from observation. But the far-sighted may ask: What of gas? Can there be another revolution to put it back into the race? Those familiar with gas lighting and with the perfection already obtained in mantle lamps (in so far as the term perfection is allowable for any device having such serious drawbacks),, agree in answering: "No." And if any striking confirmation is needed, it can be found in the attitude of the genius who brought gas lighting as far as it could be brought, Dr. von Welsbach. For instead of skirmishing after the unattainable in the way of a still more efficient gas lamp, he has for years been working on new ways of making filaments for incandescent lamps. It is he who produced the practical incandescent lamp having a filament made of osmium, since which time he has also been using some of the same rare elements which made his gas mantles a success. Here in America those interested in the sale of the Welsbach gas mantles have been studiously quiet about this recent work of their famous leader, but abroad their colleagues have made no secret of it. There they frankly admit that they have read the handwriting on the wall and that to stay profitably in the lighting supply business they must be ready with tungsten lamps or their equals so as to have something to offer to their old customers as fast as these discard their gas service. Already British and Australian journals are carrying large advertisements of Welsbach incandescent lamps, openly offered on the market by the same companies which thrived heretofore on the making of gas mantles. Of course their old patrons have not been slow to draw the logical inference from these advertisements, for this is a case where even he who runs may read.

Nearly a quarter of a million dollars worth of electrical apparatus was shipped from the United States to the Philippines last year.

"Electric Girl" Shows

P. T. Barnum's celebrated dictum that the public likes to be humbugged, seems to be just as true today as it was in the years when the great showman accumulated his fortune partly by playing upon this trait of the American people. To provide many present day vaudeville acts, therefore, embodies the making of commonplace actors appear as if they possessed unusual talent. For instance, here is a promotor who points with pride to the "Electric Girl" Shows, which proved such a fine money maker at a popular seashore resort last summer. The posters billed her as "Electricia: The Girl Who Tames Electricity" and the barker at the entrance to the show proclaimed her as the only woman in the world strongly possessed of this magic power. These unusual powers were impressively shown by glaring posters, one of which pictured her as an infant sending out sparks that nearly stunned the attending physician; another showed her lighting gas jets with the sparks which freely flow from her finger tips and still another as driving an electric automobile at high speed with the

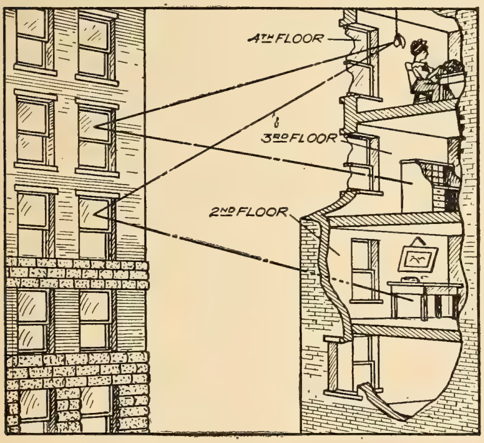

ELECTRICIA
THE GIRL WHO TAMES ELECTRICITY
SHOCK TO CROWD
AUTOMOBILE WITH THE
ELECTRICIA DEFYING THE ELECTRIC CHAIR
VOLTS IN HER BODY

electricity furnished by her own body. Surely we would expect to search the country for decades to find even a single manifestation of such rare powers. But no, the promoter who offers to furnish this "act" for $175.00 assures you that "the audience thinks it is all in the powers of the girl, but any girl can do the act as she has no speaking part."

Of course an induction coil with impressively large dimensions forms part of the outfit. Its crackling sparks terrify the audience and seem to be truly tamed by the girl wonder who, according to the posters, has 50,000 volts sent through her while strapped in an electric chair said to be a duplicate of the ones used for electrocuting murderers in New York state. The stage manager vividly describes the enormity of this voltage and the marvelous power which the young woman must have to outlive the same, but the provider of the apparatus assures us that "the chair is secretly wired so that the girl scarcely feels the electricity."

Using Windows as Reflectors

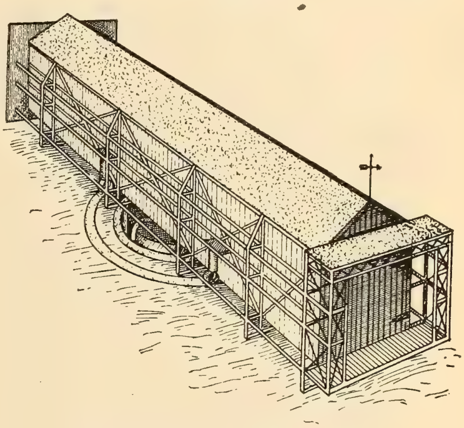
One of the older buildings opposite the new and magnificent LaSalle Hotel in Chicago is occupied partly by a group of lawyers and real estate men who have their letters and briefs transcribed by a public stenographer on the top floor. As she goes to some of the offices for her dictation, others were frequently puzzled to find her at her own room. When the new hotel building was erected, they were agreeably surprised to find that its windows acted as reflectors so as to reveal her at her post when in her own office. Then the question still remained as to whether or not she was busy with other work. To save her patrons from puzzling about this, the clever stenographer has arranged her electric lamp where it can be seen in the window reflections. Ordinarily the reflector which shields her eyes from the light throws it on her work, but when at leisure she turns the reflector to throw the beam towards the opposite windows. This simple and most inexpensive method of signalling is said to work like a charm and implies that most of us in our endeavors to utilize everything about us may have overlooked the reflecting power of the windows across the street.



THE SCHEME OF THE CLEVER STENOGRAPHER

Housing Dirigible Balloons

When an automobile approaches its garage it can easily swing around so as to enter the doorway squarely, no matter in what direction the latter faces. In the case of aeroplanes the turns are more difficult to negotiate with exactness in other than calm weather, and with a dirigible balloon a side wind may make it impossible for the craft to enter its garage safely. Nor can the dirigible leave the garage without the risk of scraping its sides if the wind comes from one side, even though the breeze may not be severe enough otherwise to interfere with the aerial trips.



REVOLVING BALLOON SHED

A German structural steel builder, August Kloenne, has designed a garage for dirigible balloons which can readily be rotated to match the prevailing wind. For dirigibles of the Zeppelin type this means a building 480 feet long, with folding doors giving a clear opening 63 feet wide and 63 feet high. The whole building is supported by trusses from a disk floating in a basin of water under the center of the garage, although ordinarily the weight rests on trucks running on a circular track. When the garage is to be turned, pressure from a motor driven air compressor raises the level of the water until the floating disk takes most of the weight off the trucks, allowing a 50 horsepower electric motor to rotate the building quickly to any desired direction. The doors are also opened and closed by means of electric motors, either operation requiring only two minutes.

Ice Skating All the Year Round

You will remember that old rule in your school physics "Rolling friction is less than sliding friction." Primitive man who lived where ice and snow ruled the earth for part of the year ignored this law. He had not reached that stage where he could readily fasten wheels upon his feet, but he did accomplish results by making for himself a pair of skates out of the shin or rib bones of an animal. He tied one of them to each foot and so worked out a way of going over ice and crusted snow from one place to another with speed and little effort. In Guild Hall, London, is a collection of these skates of bone.

Some 560 years ago came the wooden skate shod with iron, then the all-metal skate, and finally the Norwegian skate fastened permanently to the shoe.

We are not told whether the first ice "bone skater" used his devices for work or pleasure, but we must thank him for the hint, which, transformed into an improved art is a national pastime in at least one country of Europe, and a pleasure in others where the season permits.

And now, thanks to electricity, which, as a cheap, flexible source of power and an illuminant for great halls and interiors we are even permitted to have ice skating all the year round. By means of electrical refrigeration the story of the snow ball in the hot place has been revised.

Within Chicago's "Ice Palace" the cold of winter prevails at all seasons. Some idea of the interior is here shown—a pond of ice one-ninth of a mile around; seats for 2,000

Morris Wood INTERIOR OF CHICAGO'S ICE PALACE **Herman Leweck**

people; the whole interior brilliantly lighted by arcs. Winter or summer you may here put on your skates, don a sweater and with the band playing "Alice, My Ice Palace Queen" have all the fun and pleasure of real ice skating.

Two big electrically driven compressors by means of ammonia, chill a brine solution which electric pumps then force in its frigid condition through fifteen miles of pipe lying on sand under about four inches of ice. By flooding the surface of the ice with a thin layer of water and starting the motors a fresh glary surface is formed in a few minutes and grandfather's rule "Cracks she bears, bends she breaks" for judging safe ice is all upset, for electrically made ice-rink ice is always safe.

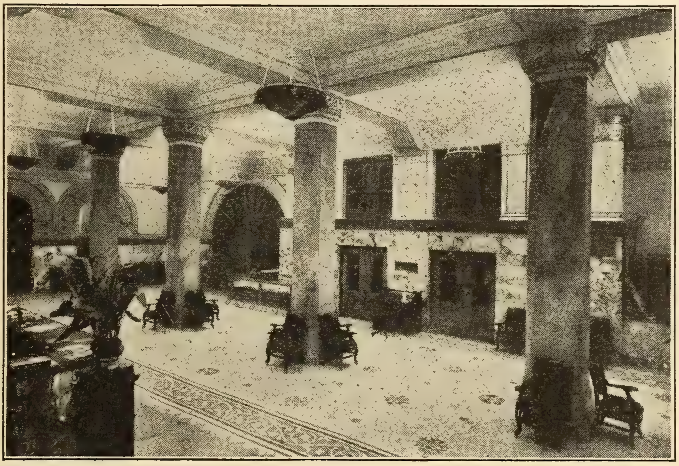
On the right of the picture is Herman Leweck, champion backward skater and jumper; on the left Morris Wood, champion professional speed skater of the world as posed on the ice in the rink. Hockey, racing and other ice sports are put on to entertain patrons and instructors are provided to teach beginners.

London has three rinks of this kind, Paris two, and Berlin the only one approaching the Ice Palace in ice surface. Besides Chicago there are rinks in Boston, New York, Philadelphia and Cleveland.

LIGHTING THE LOBBY OF A FAMOUS HOTEL

Not only are the modern new hotels installing every modern appliance for the comfort and convenience of guests, but the old established hostelries are rearranging their lobbies in the most artistic, attractive and homelike manner.

The reasons are obvious. With the number of new hotels starting in almost every city, it is necessary for the older hotels in order to retain their patrons, to follow suit.



INDIRECT ILLUMINATION OF THE AUDITORIUM LOBBY

The interior shown here, that of the lobby of the Auditorium Hotel on Michigan avenue, Chicago, is familiar to thousands, from coast to coast. Previously lighted with large numbers of exposed direct incandescent lamps, a cluster being in the center of each of the 16 by 24 foot bays, as well as the arches being outlined with them, presented a glare and blaze of light. Very efficient, but trying. The beautiful architecture was shown to poor advantage.

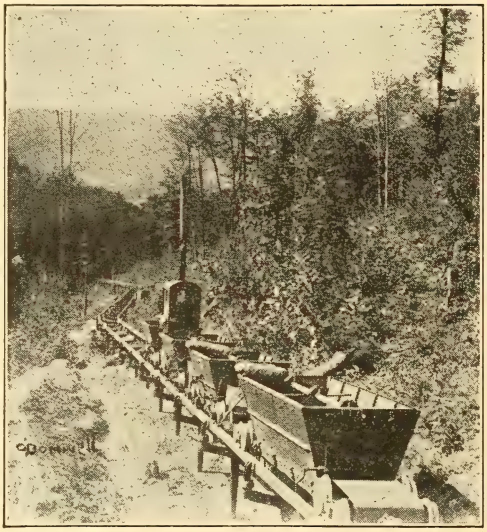
All these glaring lights have been discarded and it would hardly be recognized on account of the radical change made in the method of illumination. The charm and comfort of the present indirect lighting arrangement may be partially realized from the accompanying illustration which was made from a photograph taken by the light of the system.

Suspended by chains from the center of each bay are artistic bowl fixtures, classic in design, each containing five powerful reflectors of scientific design with a 100-watt Mazda lamp. These indirect lighting units are hung five feet from the ceiling which is 24 feet high. The light thrown to the ceiling (finished in ivory and white) is reflected back again to the working plane, and diffused throughout the room in a flood of comfortable even illumination.

The lighting of a ceiling has the effect as architects say, of raising the ceiling, and the beautiful architecture of this Auditorium lobby is now shown off to the best possible advantage.

Automatic Transportation

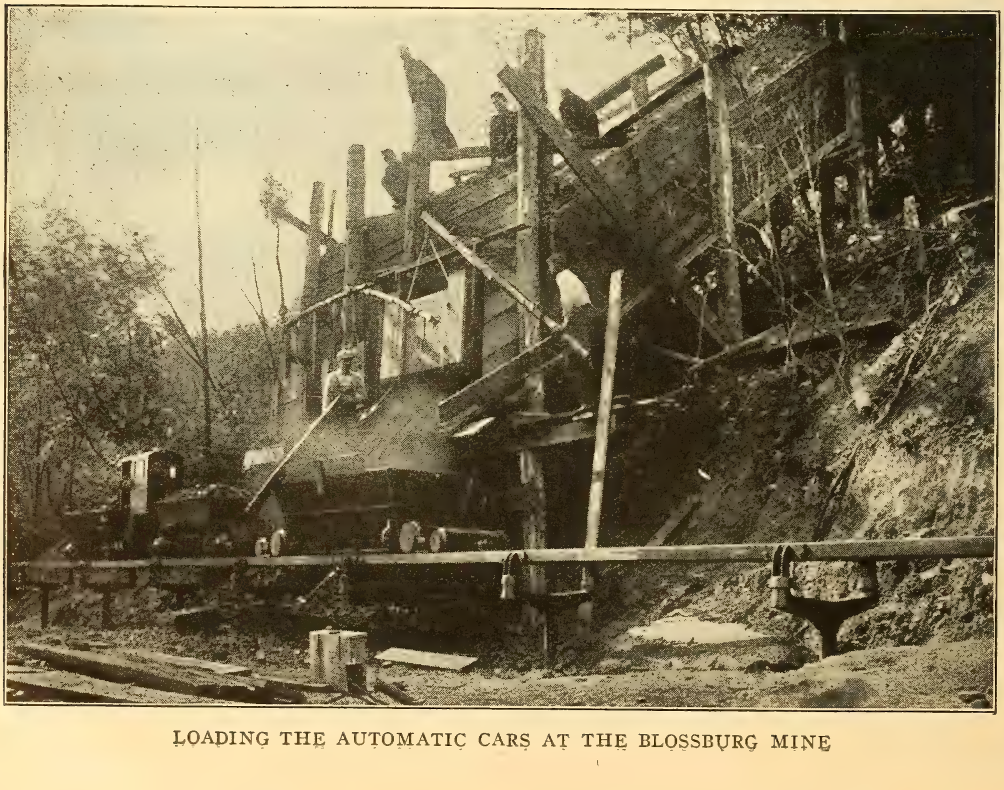
As far back as the October, 1908, issue of Popular Electricity a brief description was given of the unique system of automatic transportation devised by William C. Carr. Since that time some improvements have been made and the system has actually been put to practical use in and about coal mines. No doubt our new readers will be interested in a description of the unusual features of the automatic cars and their operation.



AUTOMATIC COAL RAILWAY AT BLOSSBURG

In the first place it is designed to give better transportation facilities over relatively short distances—as a feeder, so to speak, to systems of a greater scope, such as electric railways and steam roads. It comprises a series of concrete or metal posts capped by malleable iron Y's, which support a double steel track of 30-inch gauge elevated above the ground. The carriers or motor cars are intended to travel automatically on these parallel rails at any desired rate of speed up to 40 or 50 miles an hour.

The designs of the company building the cars and tracks are quite comprehensive in their scope and include cars for a variety of purposes. All these uses have

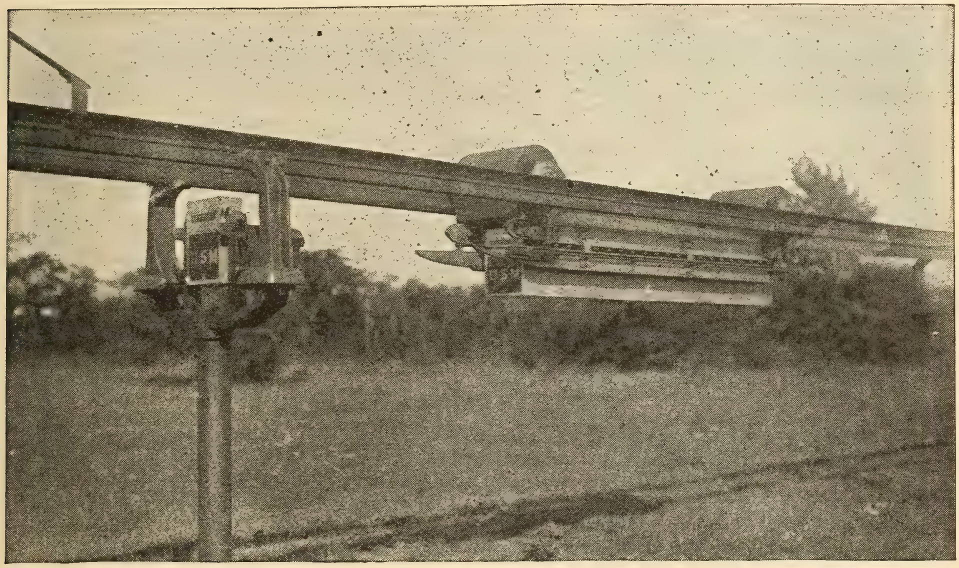


LOADING THE AUTOMATIC CARS AT THE BLOSSBURG MINE not been demonstrated by practical commercial operation but the pictures show the development to which the promoters hope to arrive in time.

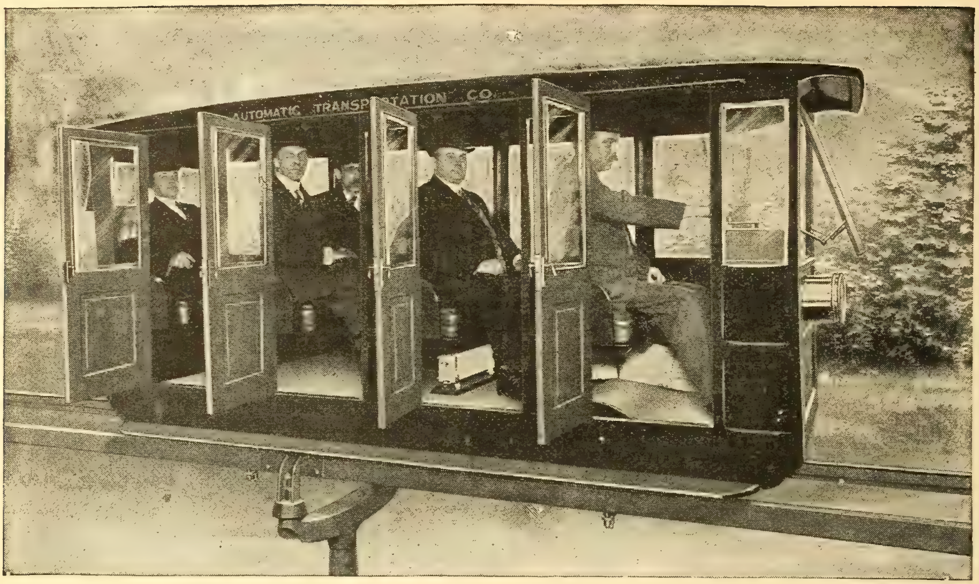
Following are the uses planned for the system: Ore carriers capable of conveying large quantities of ore, sand, coal, lumber, etc.; specially constructed passenger cars equipped to operate on automatic transportation tracks; mail and package carriers designed especially to serve rural communities; concrete tube systems for use underground in congested centers of population; flexible tracks with electric truck scales for moving freight in railroad terminals and manufacturing plants; electric truck scales, that require no tracks, equipped with storage batteries and provided with special weighing attachments that record the individual weight of each package as well as the combined weight of a truck load, also specially designed for use at railroad terminals.

One practical application which has been made at one of the coal mines in Blossburg, Pa. The track is a mile in length and is built by placing the rails on insulators supported on Y-shaped iron posts resting in concrete. One side of the track serves as a trolley, the other as a return. To prevent sleet and ice from interfering with the operation of the line the "trolley rail" is V-shaped on the under side and in this groove the trolley runs. A train of two motor cars and four trailers will carry 16,000 pounds of coal at a trip. The carriers may be automatically operated, dumping the coal and returning empty to the loading chute at the mine. Horses were formerly used, but the railway performs the service more quickly and economically.

In all cases except the storage battery truck, it is intended to have a central generating plant to furnish the power, or else buy the power from a central station or railway company. In the case of the passenger cars it is of course unnecessary to have the automatic feature, as a motorman could ride in the car to operate it, as shown in one of the pictures, which illustrates an experimental equipment. It is in the automatic package delivery, however, that the most interesting features are exhibited. It is intended to send these little cars out over a system something after the manner of a cash carrier in a department store only the cars are self-propelled, by little motors, and will travel up hill and down dale. In delivering mail for instance, in rural communities, it is planned to direct these cars from a central operator. The car will slow down automatically, leave a mail box containing the farmer's mail locked in a station in front of his house, ring an electric bell in the house, pick up a box containing

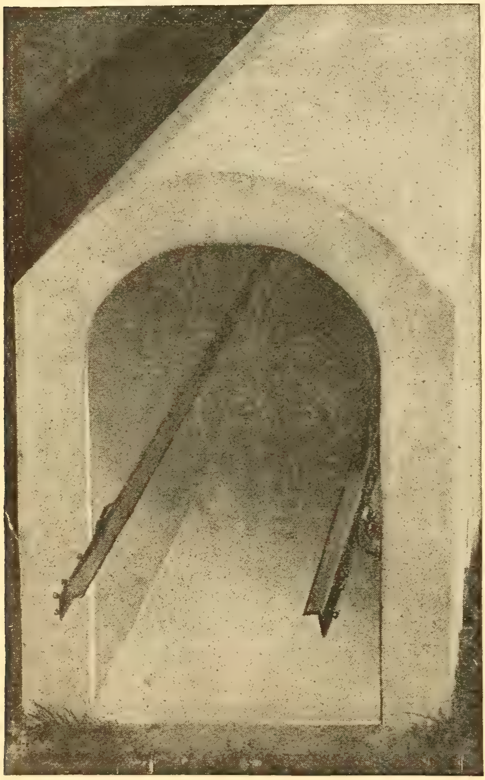


AUTOMATIC RAILWAY AS PLANNED FOR PACKAGE AND MAIL DELIVERY



AUTOMATIC RAILWAY AS PLANNED FOR PASSENGER SERVICE

outgoing mail and proceed on its way to the next station, going at the rate of 20 to 30 miles an hour. The same method would be employed in delivering and collecting packages of merchandise.



AUTOMATIC RAILWAY THROUGH TUNNEL

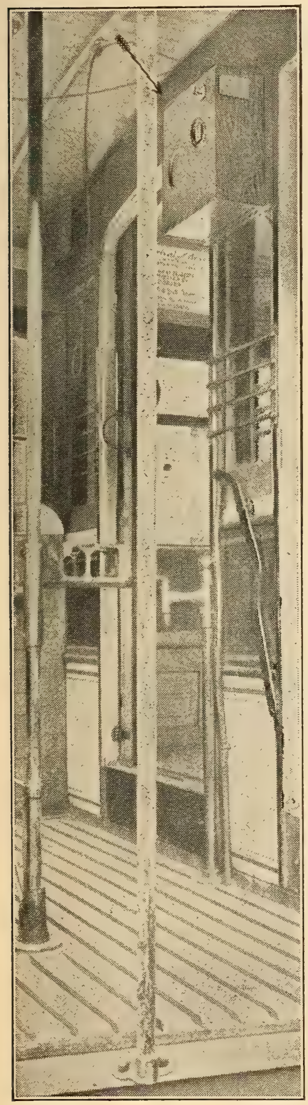
Whether or not such systems will be put into practical operation to any considerable extent throughout the country is, at present, a matter for conjecture. It takes a long time to convince the public of the merits of a new departure such as this. It is conceivable, however, that in communities too sparsely settled to support an electric railway, that such a system might be employed to advantage as the cost of installation would be far below that of an ordinary railway.

On the whole these pictures give rise to interesting conjectures. Is it not possible that some day great power generating centers will be created at the coal mines and the water power sites; that this power created cheaply, in bulk, will be transmitted to points along the railroad trunk lines, and these lines be all operated electrically by large electric locomotives drawing trains; that the trunk lines will be fed by electric trolley and third rail lines, as is now quite largely the case; that then, in turn, these full size electric railways may be the collectors for tributary monorail lines of a type similar to the one described—the whole spreading out in one intricate net work of trunks, feeders and subfeeders, all operated by electric power?

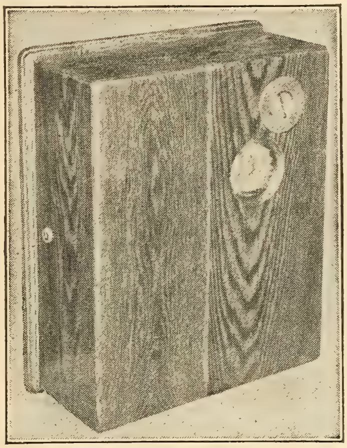
Recording the "Coasting" of Cars

Few recent inventions are as unerring in figuring out the errors of the individual man and enabling an indiscriminate judgment to be made of the capabilities of railway employees as the new device just put into use on the lines of the Interborough Rapid Transit Company of New York City.

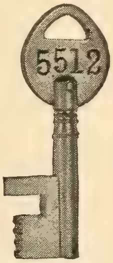
This appliance takes the place of the inspector or "spotter" of the railway who, riding about in different cars unbeknown to the crew, takes notes on the way the motorman runs his car, whether he uses more or less power than he ought to and coasts as far as the stored up energy of a car will allow him. Its name, "the coasting time recorder," gives a good idea exactly what the device is intended to do and, being the product of the ingenuity of officials of the largest of New York's electric railways, it does it. At the same time the motorman feels an interest in having his record show up as good as possible, instead of being incensed at knowing "spotters" are watching his movements.



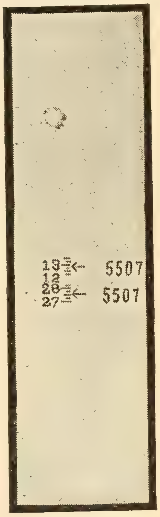
COASTING RECORDER MOUNTED IN THE VESTIBULE OF A CAR



COASTING RECORDER



THE MOTORMAN'S KEY



A SECTION OF THE RECORD TAPE

The object of the coasting time recorder is to secure a comparative and certain record of the efficiency of the motormen in running cars. It had been demonstrated by tests on the Manhattan Elevated with wattmeters that the difference in kilowatt hours used by different motormen on the same stretches of track, with the same car and exactly similar conditions of power, varied from slight amounts to as much as 30 per cent. Carelessness in running a car and not coasting as far as practicable accounted for the latter high figures.

Investigation proved that a permanent record of the time spent in coasting possesses certain advantages over a record of the time that the source of power was drawn on. It not only makes the motorman careful to go as far on as little power as possible but it also indicates to the officials the braking efficiency or quickness of stopping when occasion demands it.

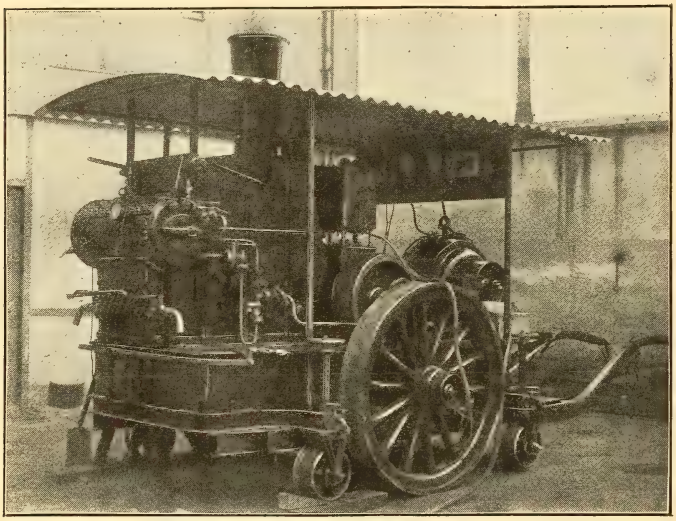
Essentially the device consists of a clock movement which engages a type wheel. The type wheel indicates the time in raised figures and a paper tape is fed under the type wheel upon which is printed the coasting time each time the motorman inserts his key and turns it. The clock is stopped and started by a magnetic brake which is actuated by magnets, the brake being withheld as long as the power is shut off and applied when the brake of the car is thrown on.

Each motorman is given a numbered key which he inserts and turns on starting on his run. This records his number and records the initial reading of the clock. The motorman then goes on his run and when at the end of the trip he again inserts his key and turns it a printed record of the elapsed coasting time is delivered from the box in which the machine is mounted. This record is delivered at the superintendent's office and filed. This enables the motorman to correct his abuse of the company's power and gives the company an idea of the comparative efficiency of the motormen.

A record ribbon photographed as delivered after the run shows that motorman 5507, during his total run, coasted from 13 minutes to nearly 28 minutes, making a total of about 15 minutes' coasting time for the entire run.

A Portable Electric Plant

Foreign engineers are highly skilled in the design of compact, portable outfits for generating electricity. One of the latest ideas in this line is French portable electric light plant embodying a steam engine and boiler on wheels, dynamo, switchboard and all accessories.



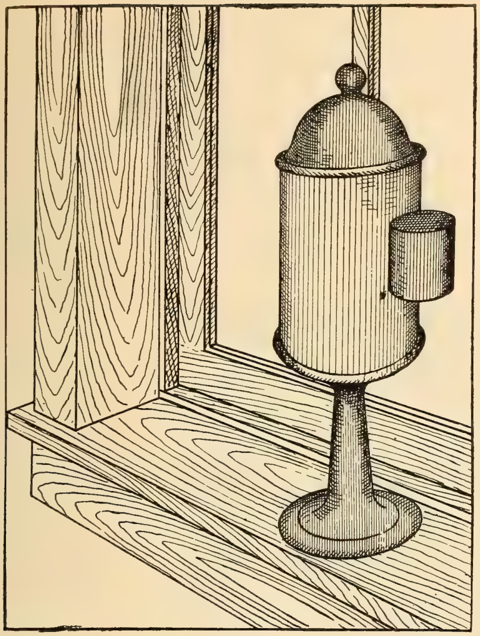
A PORTABLE ELECTRIC PLANT

The steam engine is mounted in the center of the portable plant as noted in the illustration, directly back of the boiler, and develops 40 horsepower. The dynamo is driven from the engine by belt transmission, an idler pulley being used on account of the short belt. The total weight of this portable steam-electric plant is about five tons, and not being self-propelling is drawn about by horses.

A Window Advertising Novelty

Some two years ago the former general manager of Marshall Field & Co., Mr. H. G. Selfridge of Chicago, surprised the mercantile world by establishing a department store modeled on American lines right in the heart of London. Among the characteristic features which shocked the old London shopkeepers were the huge show windows which were brightly lighted every evening, while theirs were carefully concealed by iron shutters pulled down at dusk. The evident success of these window displays in attracting trade has had its effect on Mr. Selfridge's competitors who are gradually improving their store fronts and catering to the spectators even after their closing hours.

Indeed, some of them have lately been skirmishing around for new effects to catch the eyes of the thousands who pass by their stores at all hours. One of these, which has been successfully holding the attention of the crowds, is a display of canned goods (or as the English call them "goods in tins") consisting of a series of columns with the labelled cans rolling around them without visible means of support. Some of the columns had only one can slowly rolling



WINDOW ADVERTISING NOVELTY

around each while others had several that apparently were chasing each other around the advertising pillar. Of course, the secret involves magnetism as each column contains an electro-magnet slowly rotated by a small motor. The cans are empty and where they are made of brass (as in the case of mushroom cans) an iron tube rolling inside each can keeps it close to the column opposite the slowly revolving pole of the concealed magnet. The effect of these magically suspended and slowly gyrating objects is said to be all the more weird as the moving cans look exactly like the regular stock article as stacked high in the same windows.

Is it Alternating or Direct Current

"How can I tell whether the current I am using is alternating or direct?" is a question frequently asked by our readers.

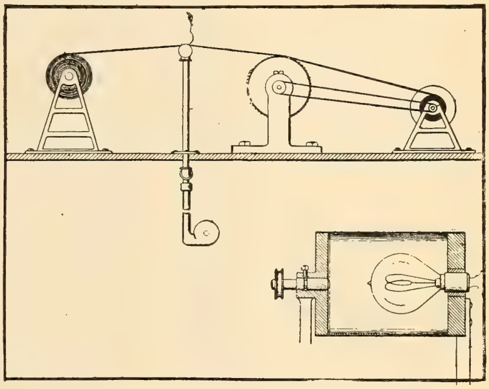
Take a simple bar magnet and hold it near a lighted incandescent lamp. If the current is alternating the filament will vibrate, if direct, the filament will be attracted or repelled according to the sign of the magnet pole held near the lamp.

Preparing Moving Picture Films

The picture thrown upon the screen at a moving picture show is many times larger than the picture on the film in front of the lamp. Great care must be taken, therefore, in preparing films to have the surface free from all dust or other foreign particles, as these magnified when thrown upon the screen would spoil the picture.

A device for cleaning the film and for placing identifying marks on it by photography is the subject of a patent issued to Gustav E. Hoglund of Chicago, Ill.

In preparing the film a delivery reel of it is placed in position as in the upper illustration. The end of the film is then passed between two cylindrically shaped sucker heads. Each cylinder has a small opening in it next to the film, and by piping and an electric fan or other means of producing suction, dust particles are removed. The film then passes over a drum equipped with sprocket teeth arranged to engage with the holes along the edge of the film. Just outside of these teeth on either side is a ring of holes opening into the drum which is hollow and contains an electric lamp. Over each of these holes a stencil letter may be placed, and as the film passes over the openings with the drum revolving, letters, words, or trade marks may be photographed on each outside edge.



PREPARING MOVING PICTURE FILMS

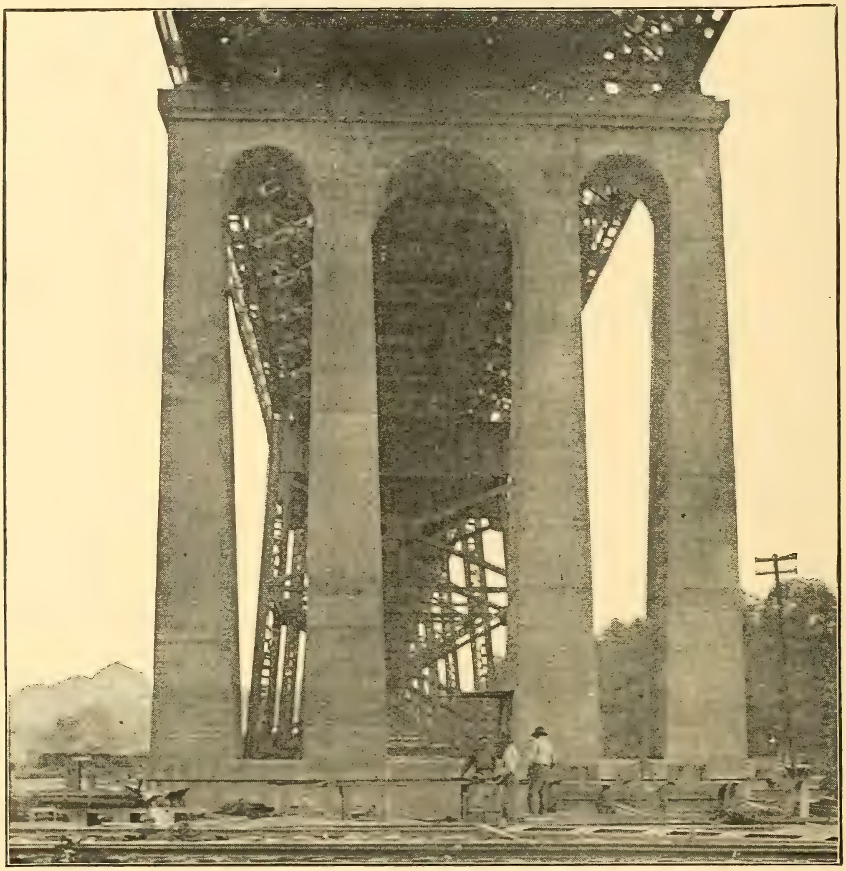
There are at present sixteen cables across the Altantic. Two of these are owned by the Western Union company, four by the Anglo-American, one by the Direct United States, five by the Commercial, two by French and two by German companies.

Garbage Made into Electricity

Hamburg, Germany, not only disposes of its garbage most satisfactorily but realizes a revenue from it. Four-wheeled water-tight iron carts are used to convey the garbage to an incinerating plant where it is reduced to ashes. The cart bodies are lifted from the wheels by electric traveling cranes and the contents discharged directly into the furnace. One electric cart is now in use and more will be purchased until no horses are in service. The slag from the furnaces is broken up during which operation an electro-magnet removes all small pieces of iron. The scrap iron is sold at auction and the slag brings 24 cents per ton being used for roadways, paving blocks and for manufacturing slag bricks. From the garbage furnaces sufficient power is obtained to operate the cranes, slag breakers and lighting plant, besides furnishing current for the storage battery of an electric launch and an automobile.

A Half-million Dollar Viaduct

At a cost of half a million dollars the Denison-Harvard viaduct will soon be completed across the river in Cleveland, Ohio. This great piece of engineering is three-quarters of a mile long and provision has been made not only for car tracks but also for carrying over all light, power and telephone wires. Some idea of the immensity of the structure is conveyed by the picture of one of the concrete piers supporting the roadway. From the surface of the water to the sidewalk on the viaduct is 103 feet high.



THE GREAT CLEVELAND VIADUCT FOR CARRYING ELECTRIC RAILWAYS, LIGHT, POWER AND TELEPHONE WIRES

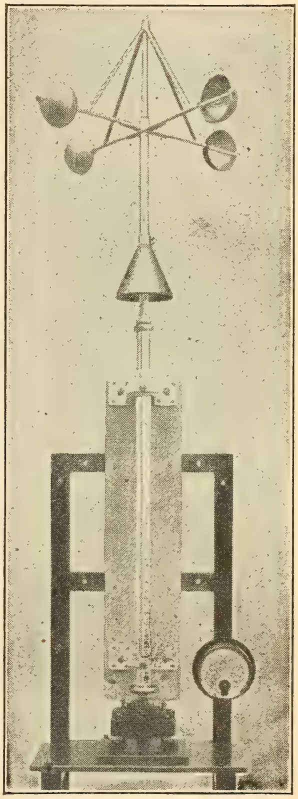
Leg-power Electricity

A curious form of exercising apparatus has been brought out by a Virginian who had been impressed with the fact that the static electricity generated in walking over rugs is often powerful enough to give one a surprising shock when touching radiators or fixtures. If such an effect can be developed incidental to walking, it ought to be much greater if produced by deliberate and continued action. Then if the resulting gentle currents of electricity were passed through the body, they might give the same sort of a helpful stimulus that is often secured from medical batteries. Carrying out this theory, Mr. Hitt has mounted a number of brushes on a board so that the user can rest his foot on one of the brushes while swinging his other foot or ankle between another pair. If this is done in stocking feet, the resulting combination of leg exercise and electrical action is said to stimulate the system.

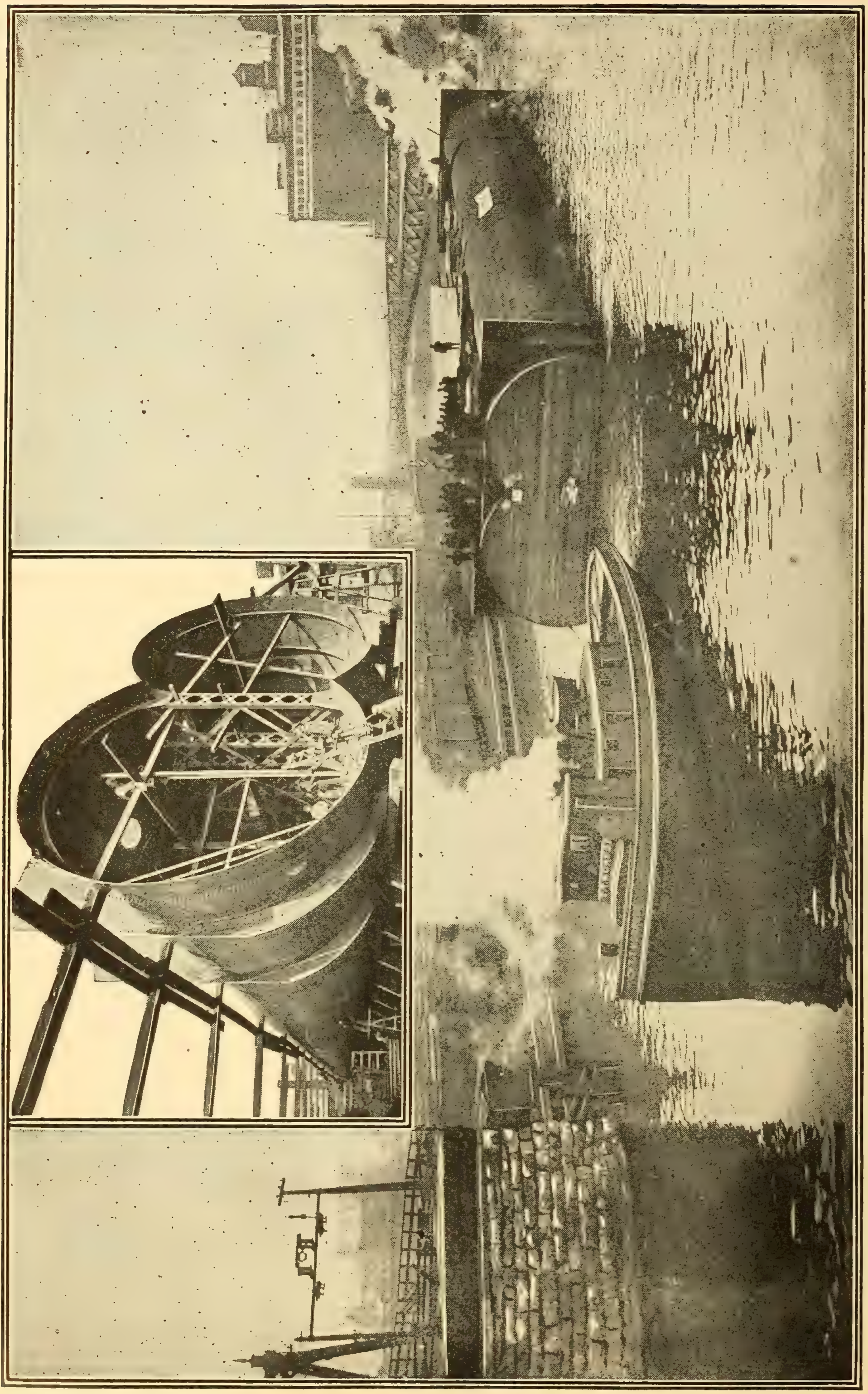
LEG POWER ELECTRIC EXERCISER

Electrical Wind Measuring

In addition to a recorder for counting the total number of miles at which the wind has passed a given point during an hour, every weather bureau and rifle range needs to have some instrument for indicating the breeze blowing at any moment. This is easily done because of the simple electrical law that the voltage of a dynamo varies with its speed, so that if we drive a small dynamo by wind power and measure the voltage, this will always be proportional to the speed. For that purpose a cross carrying hemispherical cup is mounted at the top of a vertical shaft, there being four of the cups so as to catch the wind from any direction, and the lower end of the shaft carries the armature of a miniature dynamo. From this the wires run to a voltmeter located in any convenient place, with the scale marked to indicate the wind speed to which the voltage of the current corresponds. Then if there is any movement of the air over the roof or tower on which the rotating brackets are placed, the needle on the distant indicator will tell the speed of the wind at any moment and by arranging contacts in the path of the needle, this can be made to ring alarm bells when the wind exceeds a certain rate or when it slackens again to a less dangerous speed. The device as thus pictured by us is made by Max Kohl of Chemnitz, Germany.



ELECTRICAL WIND MEASURING INSTRUMENT



GIANT TUBES FOR ELECTRIC RAILWAY TUNNELS UNDER THE CHICAGO RIVER, AND HOW THEY WERE FLOATED INTO POSITION

Through Giant Tubes Under River

A gigantic piece of engineering, costing more than $3,000,000 is going on in the heart of Chicago so rapidly but quietly that the casual observer will not know it until he finds himself some morning plunged from the light of day into a world of electric light, with concrete floor, walls and ceiling all about him and only a small circle of daylight ahead. With the time for completion of three under-the-river tunnels not far away, thousands of workers for the North and West sides who ride on surface cars to and from their places of business will, it is hoped, forget the meaning of the word "blockade," for it is to help do away with congestion in Chicago's "loop district" that these tunnels are built.

The illustration shows one of the steel tubes on its way down the river to be put in place. This double tube, weighing 8,000 tons, is 289 feet long, 30 feet wide and 20 feet high. A street-car track will occupy each half of the tube, which with the steel trusses that stud the middle, make the end view resemble the figure eight. The tube was built in a dry dock, sealed up at the ends, and in this condition towed down the river, where it will be swung into position and sunk into the bed of the river, which has been prepared by excavating with marine dredges to such a depth that the top of the tube will not interfere with the passage of lake boats, as was the case with the old tunnels. The approaches to the tunnels are of concrete and the tubes will be lined with the same material.

Trial of the Edison Battery Car

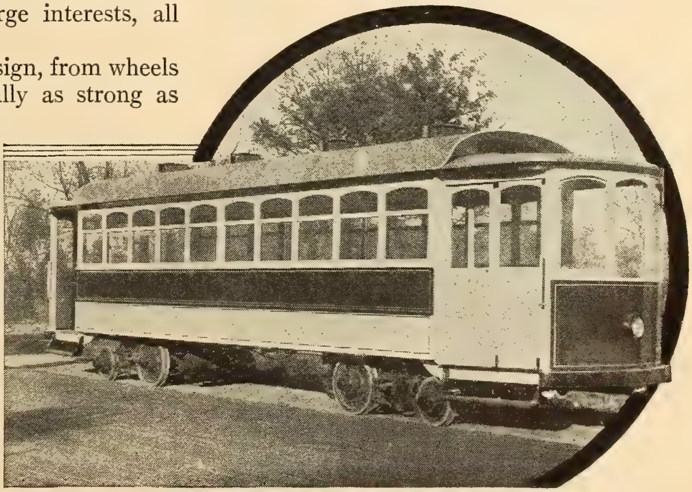
The unusual spectacle of an electric car of urban street railway pattern going at 25 miles an hour on a standard gauge steam railroad track was witnessed recently on the line of the Erie railroad, from West Orange to Forest Hills, New Jersey.

Thomas A. Edison was a member of the party watching the car, for the motive power was the storage battery invented by him, the first of its class to prove practical in its application to the railway passenger traffic problem. With Mr. Edison were President Underwood of the Erie and a number of other representatives of large interests, all concerned in the trial.

The car used is of new design, from wheels to roof. It is light, yet fully as strong as if it weighed ten times as much, as far as practical demands are concerned.

The unnecessary consumption of power on cars obtaining with the solid axle car, is eliminated. Naturally, when two wheels are joined together rigidly on the same axle, and the car is forced around a curve, the outside wheel travels a great deal further than the inside wheel. Therefore, the inside wheel must slip and grind against the inside rail with consequent enormous consumption of power and wear of wheel and rail. With this car each wheel is as independent as are the wheels of automobiles, turning independently on the same axle, and each wheel is driven by its own motor. These wheels are mounted on roller bearings, thereby diminishing bearing friction.

Silent chains are used to transmit the power from the motors to the wheels, with consequent quiet running and the absence of all gear noises so common with trolley cars. The battery cells—180 in all,—are under



THE EDISON BATTERY CAR

the seats. A separate set of batteries supplies current for lights.

The car travels 85 miles per charge on the basis of stopping ten times per mile, letting off and taking on passengers. If allowed to run without stops, it would probably run 125 miles. The scheduled speed is eighteen miles per hour, but the car has reached a speed of 35 miles per hour on a long, straight level track.

In place of the ordinary compressed air signal an electric signal, called the Klaxon, is used. One of these signals is mounted on the roof at each end of the car, though not showing in the picture. The Klaxon produces a loud and peculiar sound by the rubbing of a toothed wheel over a vibrating metal reed. The wheel is operated by a little electric motor which is thrown into and out of circuit by a plunger-operated switch, which the motorman actuates with his foot.

The Telephone in an Emergency

An impressive illustration of the service rendered by the telephone in time of emergency was given during the big stockyards fire the week preceding Christmas in which Fire Chief Horan and 24 of his men lost their lives and as many more were injured.

As the rumor of fatalities spread the calls over the telephone increased until, between ten and eleven o'clock, 200,000 fire-information calls an hour were being handled.

Lists of the telephone numbers of engine houses in the vicinity of the stockyards were given to the information operators throughout the city, so that callers insistent upon having news about particular members of the department could be switched to these points for extra calls.

Low Wireless Rates

The South Eastern Railway Company, which operates steamers across the British Channel has announced a new schedule of rates for messages sent from its vessels by wireless. The rate per word is to be six cents to England; nine cents to Germany, Belgium or France; ten cents to Switzerland, Italy and Austria; and eleven cents to Denmark, Sweden and Norway. These surprisingly low rates for aerograms are based on a minimum charge of 62 cents for messages to England and of 75 cents for all messages to the European continent.

ABOVE THE CLOUDS

Above the Clouds in an Electric Auto

The practicability of the electric both as a car for city and suburban use and for hill-climbing as well, was demonstrated by the successful completion of a series of remarkable tests made in New England last fall.

In one of the tests a Detroit Electric left New York September 17, arriving at Waterbury, Connecticut, that evening. From there is proceeded to Boston, thence along the Massachusetts and Maine coasts and later to Glen, which is at the base of Mount Washington and from there the actual start of climbing the mountain was made.

A blinding rain and windstorm was encountered after a climb of 6,000 feet was made. Returning to Bretton Woods, the prescribed route was again taken up and the electric continued without mishap.

The actual distance covered was 1,007.73 miles in 89 hours and 25 minutes.

Locating a Shot in the Eyeball

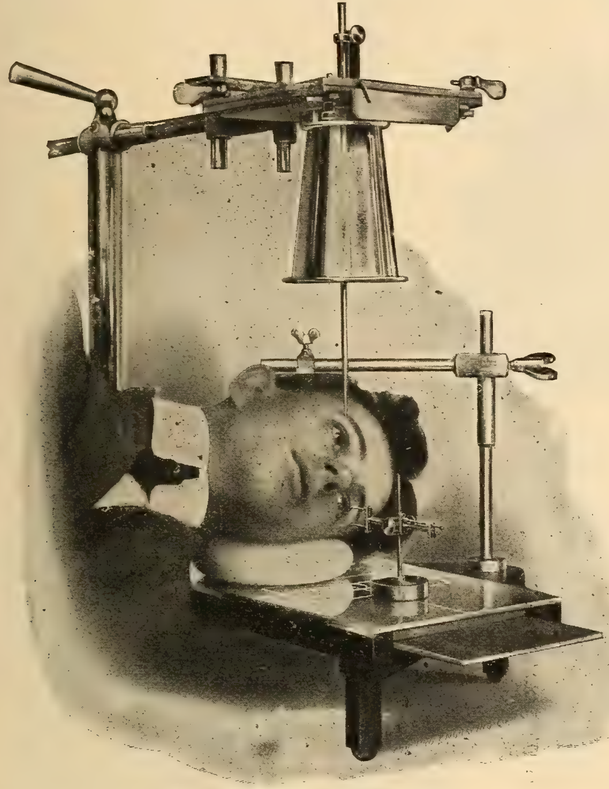


FIG. I. FIRST EXPOSURE

How to locate, with mathematical accuracy, the exact position of a foreign body imbedded in the eyeball is a problem which has been successfully solved by an ingenious application of the X-ray. This is known as the Sweet method, after its inventor, Dr. Sweet. Manifestly, taking one photograph of the eye by X-rays would show the body, but we would not know how far in. To locate it exactly a second picture must be taken at a different angle. To do this and locate the spots takes a device of some ingenuity, as shown in the pictures.

In Fig. 1 we see the stand on which the patient's head rests, on a pneumatic cushion. In the lower part of the stand is a sort of drawer holding the photographic plates. The upper surface of the stand is made of aluminum, which allows the X-rays to pass through. On it is marked a diagram, with a little circle, directly over which the eye is to be placed. Above the head is a sort of funnel which directs the rays from the X-ray tube downward along the line of the needle pointer.

In front of the patient's eye is what is known as the localizer. On the projecting bracket arm of the localizer are carried two small prongs with metallic knobs on the ends, one round and the other slightly pointed. The two arms carrying these knobs are at a known distance apart.

The little base carrying the localizer is moved up to the front line marked on the aluminum surface. The patient's head is then moved up until the little knobs press on his closed eyelid. Then his eye is directly over the proper place on the diagram. By an ingenious trigger arrangement the knobs are released and fly back exactly 10 millimeters, so the patient can open his eye. Next the funnel is swung over until the needle points down in a plane just touching the front of the eyeball and we are ready to take the first picture, which is as shown in Fig. 2. Here, the heavy black dot at the right is made by the two knobs of the

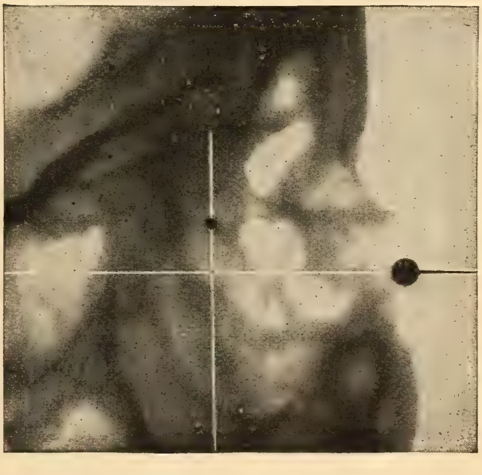


FIG. 2. FIRST NEGATIVE

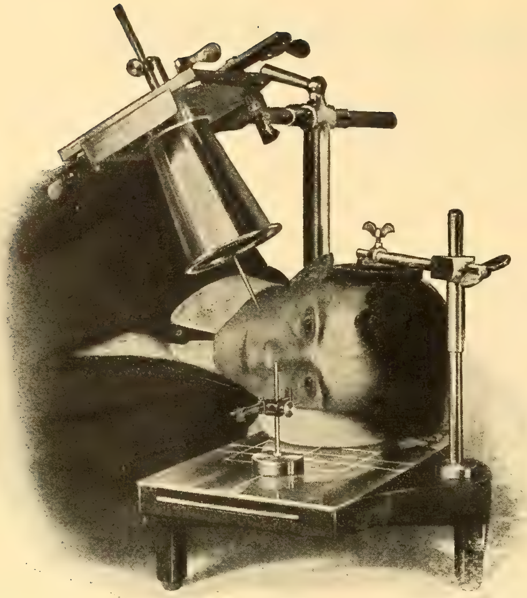


FIG. 3. SECOND EXPOSURE

localizer, for the X-rays were shining vertically down upon them in this first picture, and they show as one. The small black dot is the foreign body, in this instance a shot.

So much for the first picture; it shows how far back in the shot is, but no more. So we proceed to take the second picture, as shown in Fig. 3, moving the plate down in the plate holder so as to expose its second half. In Fig. 3 the funnel is tilted over so as to cause the light to be directed in an oblique direction, everything else remaining as before. In this case we have the negative Fig. 4. Here the upper and the lower knobs of the localizer show and eventually will give us an angle to work upon to make an exact determination of the position of the shot.

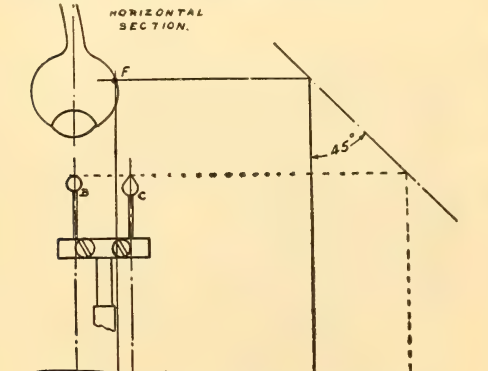


FIG. 5. PLOTTING THE RESULTS

In making the determination horizontal and vertical lines are drawn on the two negatives as shown, and then a chart is laid out as in Fig. 5. Referring to this chart (B) represents the two knobs of the localizer in the first negative. On a horizontal line through (B) lay off with dividers the distances (BR) and (RF¹) in the same relation to each other as the lines joining the two dots in Fig. 2.

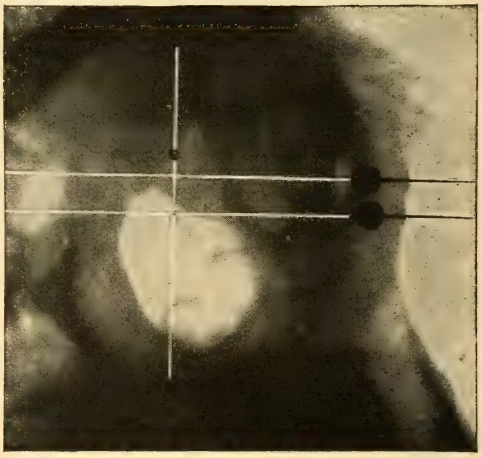


FIG. 4. SECOND NEGATIVE

Now imagine the localizer as shown at (B) to be brought up and over in the arc of a vertical circle until the two knobs (B) and (C) are projected down in a horizontal plane (Front view). We then have two points (B) and (C) located as they would be on the eyeball if we were looking straight into the eye along the line of the localizer arms. Draw vertical lines (BB) and (CC) through these points. Then lay off the distance (BP²) equal to the distance from the upper horizontal line to the shot, in Fig.

4, and (CP^1) equal to the distance from the lower horizontal line in Fig. 4, to the shot. Connecting (P^2) and (P^1) we have the line which shows the angle at which the oblique ray passes through the eye in taking the second picture. A horizontal line through (F^1 P) will intersect (P^2 P^1) at a point (F^2) which shows the location of the shot in the eyeball if we were looking straight into the latter. The distance (F^1 P), minus 10 millimeters, shows how far in the body is, and the exact position is thus deterimned.

Of course, when the two pictures are taken the patient must look at some object directly in line with the localizer arms, so that the eye will be in the same position during the two exposures.

FROM OUT THE LEYDEN JAR

All the alleyways and dark corners in the city of Washington are to be lighted at night for the suppression of crime.

* * *

In the manufacture of cable for telephone uses Chicago leads the world. It is possible to purchase an entire telephone equipment of any capacity—power, poles, wire, instruments, switchboards, etc., from stocks carried in Chicago.

* * *

The United States Steel Corporation has taken over the exclusive rights to all of the Heroult patents for electric steel furnaces for America and the manufacture of and refining of steel by electric furnaces will be made a special feature of the corporation's operations in the future.

* * *

Wireless telegraphy is to be put to another practical use. The United States weather bureau proposes to warn whalers of the Arctic fleet and merchant vessels of impending storms and the movement of ice packs if weather stations are established in Alaska and the Aleutian islands.

* * *

A new idea has been worked out in the use of the wireless telegraph on the ships of the navy, according to the annual report of the chief of the equipment bureau. A portable apparatus has been devised that will enable the long distance aerial wires to be taken down in battle and replaced by a short wire running up to the yard arm and connected to a set of instruments carried by the operator behind the armor inside the upper deck.

A feature of the voyage of the steamship Zelandia, which arrived at Victoria, British Columbia, recently, from Australia, was a chess match by wireless, between Captain Phillips and four passengers of the Zelandia and Mr. Frick and four passengers from the Makuria. The game which was won by the Zelandia in six moves, began when the steamers were in sight of each other, and the last move took place when they were 400 miles apart.

* * *

Experiments to produce iron and steel from Norwegian ores by the electric process have been made during the last three or four years, partly by aid from the government, in response to a petition sent to the Department of Commerce and Industries by the Christiania Polytechnical Society. Private interest has in this manner been awakened, and the industry now promises to become one of considerable importance. The Norwegian iron ore is often so poor that smelting by the old process was found profitless.

* * *

The Pere Marquette is soon to join the already long list of railroads using the telephone to dispatch trains, supplanting the telegraph, which was considered the standard for handling train movements for a great many years. Instruments, selectors and line material have been ordered to equip a line from Saginaw, Michigan, to Toledo, Ohio, approximately 135 miles in length, with the telephone for train dispatching. This is understood to be the beginning of the adoption of the telephone system over the entire road, extensions to follow the completion of the first circuits.

MAIN STREET, SALT LAKE CITY—PHOTOGRAPH TAKEN BY LIGHT OF MAGNETITE ARCS

Luminous (Magnetite) Arc Lamps

For a long time hard-working inventors tried to change the electric spark into a continuous glow. It was finally done but with batteries and the cost was too great. Not until Faraday in 1831 discovered that electric current can be induced in a copper wire by moving it across a magnetic field, was the way made clear to produce economically a steady light between two carbon tips by current from a dynamo. Even then, it was not until 1878 that Paul Jablochkoff lighted the streets of Paris by the "Jablochkoff candle," the beginning of the arc lamp, supplying current from a Gramme dynamo. This same year Brush brought out his arc light system in this country, and for 30 years the carbon arc lamp has held sway without any serious competition because of its efficiency in certain fields.

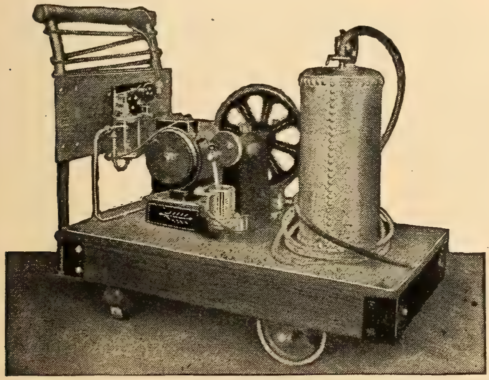
Recent years have produced high efficiency incandescent lamps but even this still leaves the arc lamp best for large interiors such as

TWENTY-FOURTH ST., MINNEAPOLIS—ILLUMINATED BY MAGNETITE ARCS mills and factories, and superior to all other illumination for street service, parks, wharves, or places where fog or smoke make a penetrating light necessary. The improvements in filament lamps have led to experimenting with the arc lamp to find a slow burning material for electrodes and thus do away with frequent trimming, and at the same time to produce an electrode using less current and giving more light. These improvements are realized in the luminous arc (magnetite) lamp.

The electrodes in this lamp differ from the ordinary carbon lamp electrodes, the upper being composed of a solid copper rod sheathed by a thin iron tube. This electrode lasts from 4,000 to 6,000 hours. The lower or negative electrode is composed largely of magnetite or oxide of iron encased in an iron tube ⅝ by eight inches, and burns from 175 to 200 hours as against fourteen hours for the open carbon arc and 24 hours for the enclosed flaming arc. Moreover the magnetite arc produces a white light, the kind most people prefer. The lower carbon feeds up as it burns away, which is just the opposite of the operation in the ordinary carbon arc. The lamp consumes one-third less energy than the ordinary carbon lamp and gives one-third more illumination.

Keeping Pumped Up

It's easy enough to be pleasant when your automobile is in trim; but the man worth while is the man who can smile, when he has to go home on the rim.

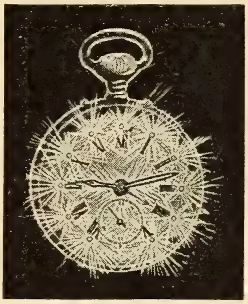


PUMP FOR INFLATING TIRES

Especially designed to remedy this most trying physical and mental condition is the Eureka electric tire inflater outfit, consisting of an air tank, electrically driven pump, and a switch controlled by the air pressure. The compressed air in the tank may be kept at 100 pounds or less as desired, the only attention required being an occasional oiling of the pump and motor bearings. This equipment reduces the labor of inflating automobile tires to making the necessary connection of the hose, and gets rid of the "Let it go this time" idea, the motor driven pump replenishing the air supply when the tank pressure drops below a predetermined point.

A Luminous Watch

German periodicals have been printing advertisements of a novel watch which looks in the picture as if it were studded with electric lamps of the size of pin heads and which is claimed to be luminous at night. It is variously offered as having an electric or a radium dial, but really turns out to be only a cheap watch with a coating of luminous paint (probably containing calcium sulphide) on the dial. The only real connection with electricity lies in the maker's advice to purchasers that they recharge the activity of the luminous dial as often as possible by exposing it to the rays of an electric desk lamp.



LUMINOUS WATCH

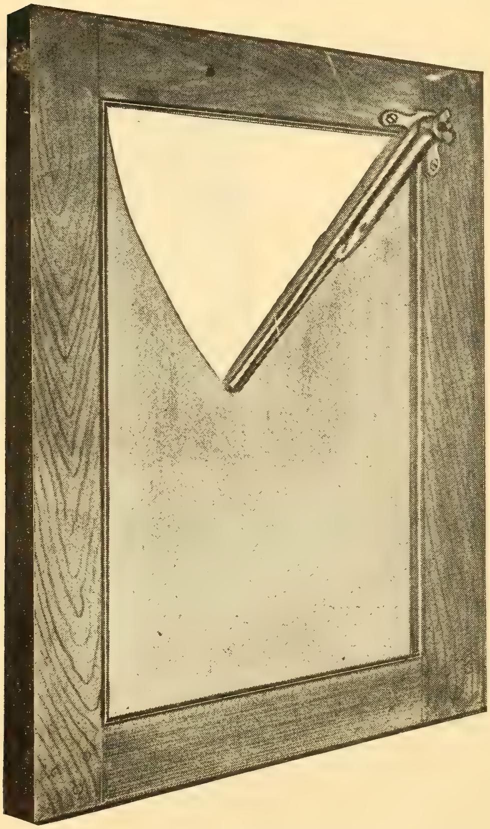
Lightning-rod Inspectors in Prussia

According to the provisions of the decree of the Prussian Minister of the Interior, of Dec. 24, 1843, before lightning-rods can be erected in Prussia permission must be obtained from the local police authorities and the work inspected and passed. Anyone who wishes to engage in the lightning-rod business must first obtain a government certificate of efficiency. This document can only be procured after having successfully passed an examination held by the police officials. The form and scope of the examinations are determined by the Ministry of the Interior.

By the terms of a general order dated Dec. 25, 1897, all lightning-rods placed upon government buildings must be inspected by an expert electrician at least once a year, to determine whether or not the rods have sufficient conductivity to carry off lightning, and once every five years the electrical resistance of the conductors must be accurately measured.

Motorman's Window Cleaner

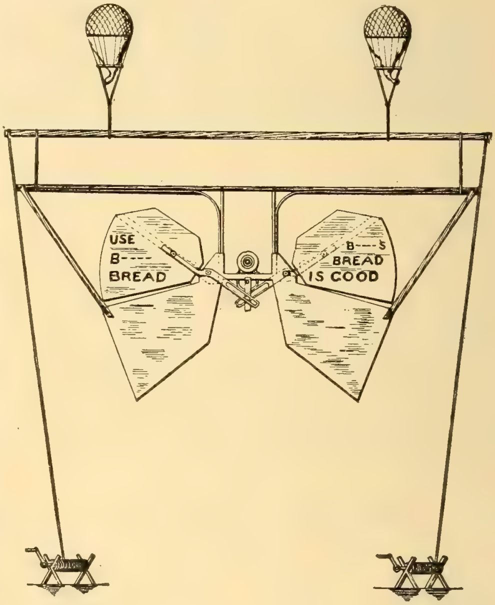
On days when the air is full of rain and sleet the motorman's window might as well be a piece of ground glass as far as its usefulness to him is concerned. Recognizing the liability of accidents under such conditions, an ingenious appliance has been devised by a Dayton, Ohio, concern, whereby the motorman is enabled to clear a section of his vestibule window with one sweep of the hinged arm which is shown in the drawing. This swinging arm, which is double and bears on both sides of the pane, carries a set of wipers similar to those used by a window cleaner.



MOTORMAN'S CAR WINDOW CLEANER

An Aerial Electric Sign

In keeping with the spirit of the day a patent has been granted to Edward Jocher, Philadelphia, for an aerial advertising sign. Two captive balloons attached to the framework supporting the sign pull the equipment up into the air as far as the windlasses and anchor ropes allow. Upon a platform of the sign is an electric motor which by levers will cause the wings to move as though the machine were in flight. Current will be conveyed to the motor and to lights with which it is proposed to illuminate the sign by electric wires within the anchor ropes. It is at least an odd looking affair, though its practicability like that of many patented devices, is a long way from being proved.



AERIAL ELECTRIC SIGN

The proposed wireless time-signal service from the Eiffel tower was inaugurated on November 21, and mariners can now receive signals at midnight and 11:00 a. m., except on Sundays and holidays.

A Life-saving Telegraph Pole

An interesting episode in which a former amateur telegraph operator showed good presence of mind, is reported from Algeria in northern Africa, where goods are still frequently transported on the backs of mules.

A French trader who was using a line of telegraph poles as his guide through a lonely district in which the roadway could hardly be distinguished, was surprised by two Arabs who promptly seized the mule and its cargo. Badly frightened, the trader ran to the nearest pole and climbed to its top, where he braced himself against the wire while the Arabs flourished their daggers at him. Then, recalling the days when he and a schoolmate had enjoyed a private telegraph line, he took out his knife and began tapping Morse code signals on the wire. According to all canons of modern fiction, his message should have been heard by distant rescuers who would entrap the bandits. In reality, no one heard his tapping except the two Arabs to whom it sounded like the mysterious message sending about which they had heard such wonderful tales in the city.

Scared by the thought that the trader might be summoning help, they fled in haste, leaving the merchant to make the astonishing report that he had saved his wares by playing again at telegraphy.

A Sure Remedy

Telephone men, when traveling on inspection trips, come in contact with a great deal of trouble caused in various ways, and when they have not a thorough understanding as to the remedy to be applied, frequently write in for information to the proper department. Recently, a manager wrote a letter to the effect "that on recent trips over —— route, south, I noticed there was considerable damage being done to cedar poles by holes being pecked in same by birds and woodpeckers." What would you suggest as a preventative?"

The man at the head of that particular department in the district replied:

"Answering your letter of recent date containing information that the woodpeckers are pecking holes in our poles beg to state that we have several remedies to offer and you can select and put any one of them in force at once, if you believe it will prove satisfactory. First—File the bird's bill off and he cannot peck these holes in the poles. Second—By first getting the size of the bird, you can easily tack sandpaper in the hole and the bird would soon wear its wings off and would not be able to fly up to the top of the pole. Third—A very simple thing is to tack a piece of tin on the spot that you think the birds are going to peck on next time.

After applying all the mentioned remedies, if they persist in destroying our property, I would suggest a remedy that would prove more effective than any one mentioned above, but would only suggest that we put it into effect as a last resort. We will get the necessary papers in order to secure an injunction from the nearest court against them to prevent them from pecking holes in our cedar poles. You will please advise the writer the result of your efforts in putting any of the remedies into effect."

—*Cumberland Telephone Journal.*

The suffragette turns from things governmental to things electrical.

How a London "ad" writer dresses up his "copy" for electrical trade paper advertising.

ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

A Remedy for Party Line Telephone Troubles

By WILLIAM J. MISKELLA

Referring back a few years in the history of the telephone, we who live in cities remember the long ugly looking wall telephone with its bells and generator crank attached to a box at the top, the transmitter inclosed in a small unsanitary wooden box in the middle and the batteries inclosed in a larger box at the bottom. In the next few years, we find this type of telephone replaced by the so-called common-battery telephone from which the generator crank has been omitted and the wooden transmitter replaced by an improved one made of metal, while the lower box has either been eliminated altogether or replaced by a box similar to the one that was originally at the top. Coming still closer to the present time, we find the mounting board equipped with an extra box known as the coin collector and at the present time a few of the telephones are equipped with another mysterious-looking box or attachment, which as time goes on, we are bound to see used more and more.

This little box is like a physician's medicine cabinet. It comes to us containing the remedies for the well-known troubles that so many of us have experienced in using the common party line telephone. These troubles are perfectly evident, but for the purpose of discussion a few of them may be mentioned as follows:

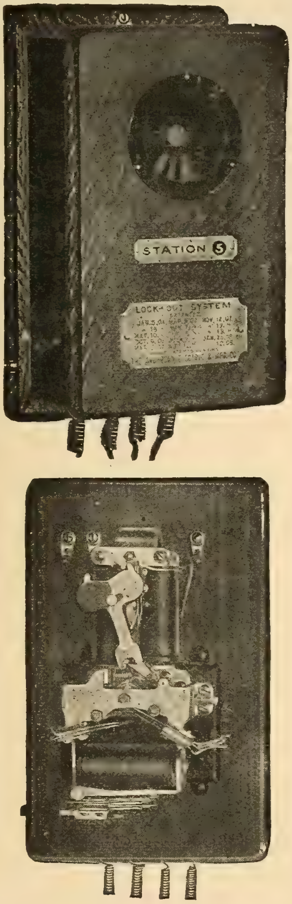
(a). Code ringing.
(b). Unwelcome and unknown parties listening to your private conversation.
(c). Annoyance to the talking parties by a third party in trying to find out when a conversation has been concluded.
(d). Aggravation of the third party in his persistent efforts to find out when he can secure the line.

In the matter of code-ringing, assuming that there are ten parties on the line and that each party gets on an average, one call per day, the fact that each party on the line is interrupted unnecessarily by the ringing of his telephone bell when some one else is desired, nine times out of the ten, should be of some concern to him. How many times have you been interrupted by another's ring even after you have retired for the night? How many times have you answered your own telephone only to be told that you were the wrong party?

There is nothing more disagreeable and certainly nothing more annoying than to have a third party hear your private conversation. This obnoxious third party cannot see the facial expressions of the persons who are carrying on a conversation and is more than likely, therefore, to cause trouble by taking statements seriously and repeating some part of an overheard conversation. It may have been that the talking parties were joking. It may have been that the "listener" erred in his judgment in regard to the identity of the talking parties.

How often have we desired to use the 'phone in a hurry and as often found someone else using the line? Regardless of how we disliked to interrupt the conversation, we were forced to test the line every few minutes to find out when it was clear for our use. Incidentally, we may or may not have heard some unpleasant remarks passed about ourselves.

However much we have been inconvenienced by these objections to a common party line, we may now repose in peace and await the day when our telephone company will come to the rescue and introduce this other mysterious little box just above our telephone. If central is supplied with a selecting key and all the parties on your line have these little boxes attached to their telephones, then it is within the power of central to transform your party line into a private line, during the interval that you are talking, and thereby lock out all the other parties on the line so they cannot hear your conversation and cannot interfere with your conversation in any way. It is likewise in central's power to ring only the bell of the telephone that is wanted and thereby refrain from interfering with any of the other parties. Should a third party desire the use of the line, in case of an emergency, provision is made so that he can signal central to that effect and central can get permission from those who are using the line, for the temporary use of it.



THE "LOCK-OUT" ATTACHMENT FOR PARTY LINE TELEPHONES

Referring to the upper one of the two illustrations we see a view of the attachment which, by the way, is known to the telephone people as a lock-out attachment. When the line is being used that fact is indicated by the color of the little red disk at the centre of the black dial in the upper part of the figure. When the line is clear, the little disk will always be white and when the line is in use the little disk will always be red, temporarily replacing the white one.

If we refer to the lower picture, the principle of operation can be seen. In the centre of this device is a little ratchet wheel which has eighteen teeth on it, one tooth for each party on the line. Just above this we see a magnet consisting of two coils and pivoted above and between these two coils, we note a long finger (back of the busy signal) which causes the ratchet wheel to revolve. If, now, we assume that party number five on this line is desired and remember that something must cause the finger to move the ratchet wheel around five steps, we can see that it will be necessary for the magnet to attract its armature, which is rigidly attached to the long finger, five times. When this is done, the proper contacts are made in the springs which are seen until finally an impulse is sent through the coil in the lower part of the figure which connects station number five in line, leaving all the other parties locked out. The selector key, which is located in front of the central operator is merely a small mechanical counting device which sends the required number of impulses over the line, depending upon which particular party is desired.

An Insulated Test Clip

"Get a better contact down there, you rummy!" This is not an unknown expression, to those who have ever assisted in testing out the fire or signal-alarm wiring of a large building, as it comes down the elevator shaft.

The accompanying illustration shows the Universal test-clip designed to eliminate testing-contact troubles and do away with the necessity of a large vocabulary. Fitted with a steel spring and made with teeth on both end and sides, it grips either fine or coarse wire or almost any-shaped line terminals and will appeal to electricians, linemen and troublemen who use the magneto and microphone test-sets. Lighting companies may use them for making voltage and wattmeter tests, while electric railway signal inspectors will find service for them on portable instruments. A rubber cover for all but the nose of the clip enables it to be connected without getting a "shock."

Electric Hair Drier

The two illustrations on this page represent the application of the Halliwell electric hair drier. The machine, which is for use in hair-dressing establishments, consists of a motor-driven, centrifugal fan, which delivers a powerful blast of air through the nozzle. The air is heated by electricity through the agency of an ingeniously contrived electric heating unit inside of the machine. The cost of operation of the device is not over a few cents an hour, even with the electric heating attachment. It will dry the heaviest head of hair in five minutes.

REACHES ANY PART OF THE HEAD

WHEN YOU WANT A BREEZE YOU CAN GET IT

A Great Power Development

About 20 miles east of Tacoma, Wash., there is to be a hydro-electric power development which will be one of the most extensive on the Pacific Coast. It will be built by the Pacific Coast Power Company, and will utilize the waters of the White River. This is fed by the glaciers of Mt. Ranier and receives its name from the milky silt which it carries and which gives it a whitish color. The water will be diverted by a small dam to an earthen ditch five miles long through which it will flow to the main storage reservoir and allowed to settle. This will hold enough water to operate the plant three or four months, should no additional water be received. From this reservoir the water will be carried 3,000 feet through a tunnel to the head basin of the power-plant. From there, a separate pipe-line will be built down to each turbine in the power-house. Here the largest water turbines ever built will be installed, each of 20,400 horsepower and each connected direct to an electric generator.

FOR PRACTICAL ELECTRICAL WORKERS

HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

The Romance of Power

By WARREN H. MILLER

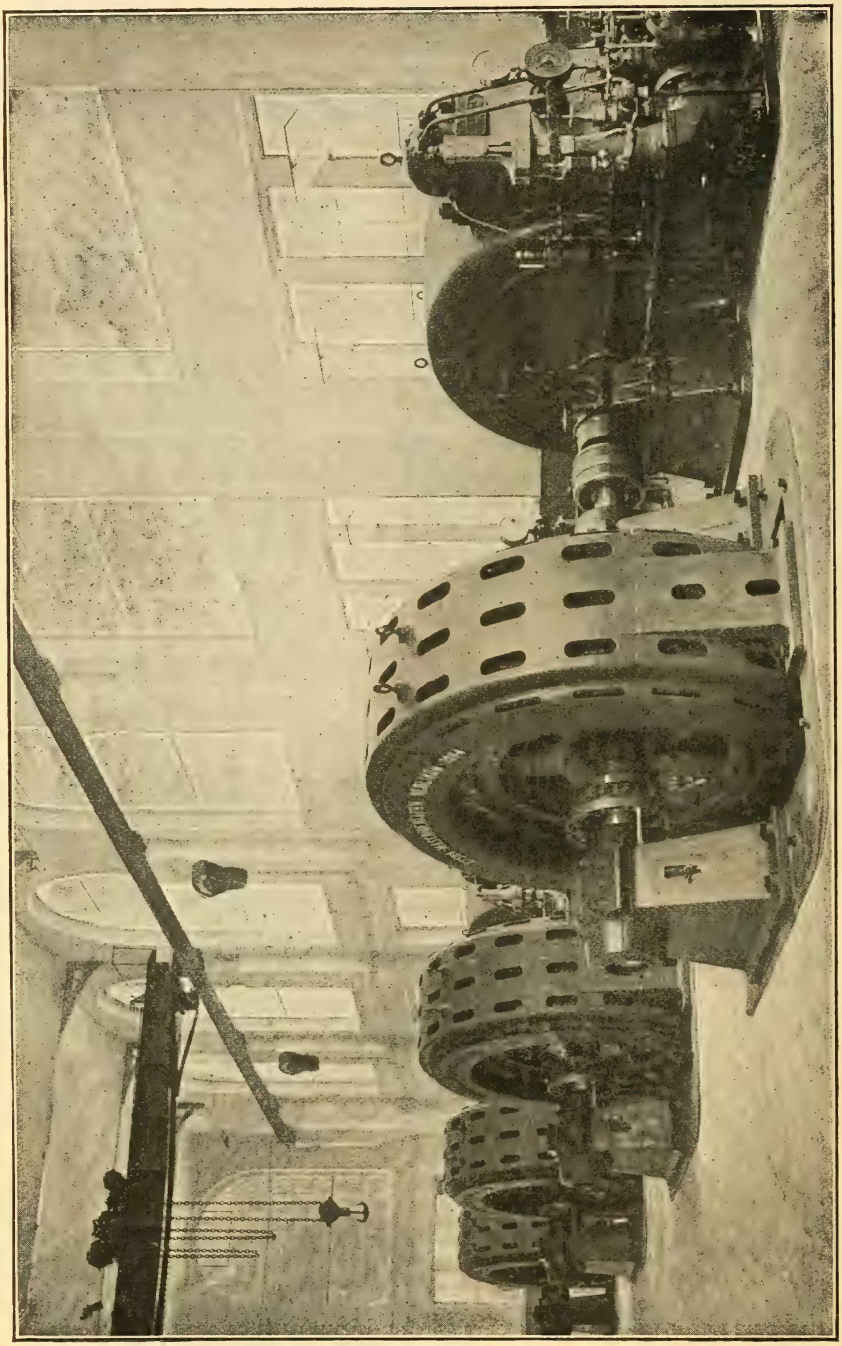
III.—HIGH TENSION TRANSMISSION

One does not realize what a wonderfully supple and obedient servant electricity is until after a study of modern long distance high-tension transmission. To think that, under the stress of the field magnets in the alternating dynamo, the electric current will rise from zero to 6,000 volts, transform to 135,000, rush out over 140 miles of wire, dash through hundreds of motors representing thousands of horsepower, fly back again to pass through zero and rise to 135,000 volts in the opposite direction; and do all this 60 *times a second*,—it makes the "wonders" of the ancients pale into insignificance! Tesla once ran a motor on alternating current with only *one* wire. He put a large condenser beyond the motor, and the currents flowing into and out of this electrical lake, so to speak, ran the motor, which was on the single line precisely like a water-wheel on a mill race.

This problem of capacity or electric reservoirage for the volume of an alternating electric current hardly enters into direct current calculations at all, as a direct current line is only charged once. About the only exception is the submarine cable. Here we have a worm 3,000 miles long,—"some" copper. You feed it full of electricity and then empty it again, and in doing so it makes a signal. That is rather different than ordinary telegraphing.

But with the 100,000 volt alternating transmission line 140 miles long from Great Falls, South Carolina, to Guilford the charging current needed to fill the line 60 times a second is 40 amperes, so that the line carries a steady charging and discharging account of 6,400 kilovolt-amperes. When this line is put on without a single motor at the other end the voltage of the generators *rises* from 1,300 to 1,800, because of the reaction of the "capacity" of the line on the alternator coils. It causes a "leading" voltage in the dynamo—the voltage rises faster than the current because the line has to be charged before the current begins to flow. However, this charging account has but little real energy loss, as none of the current is turned into work until it goes through the motors. It is a *wattless* current, and the only real loss is the heating of line and generator due to the passage of the current into and out of them all the time. The real current in kilowatts flows through the motors after the line is charged, and, as it both charges and flows through the motors in two directions 60 times a second, it becomes almost inconceivable for our intellects to comprehend how very fast a wave of electricity *does* travel.

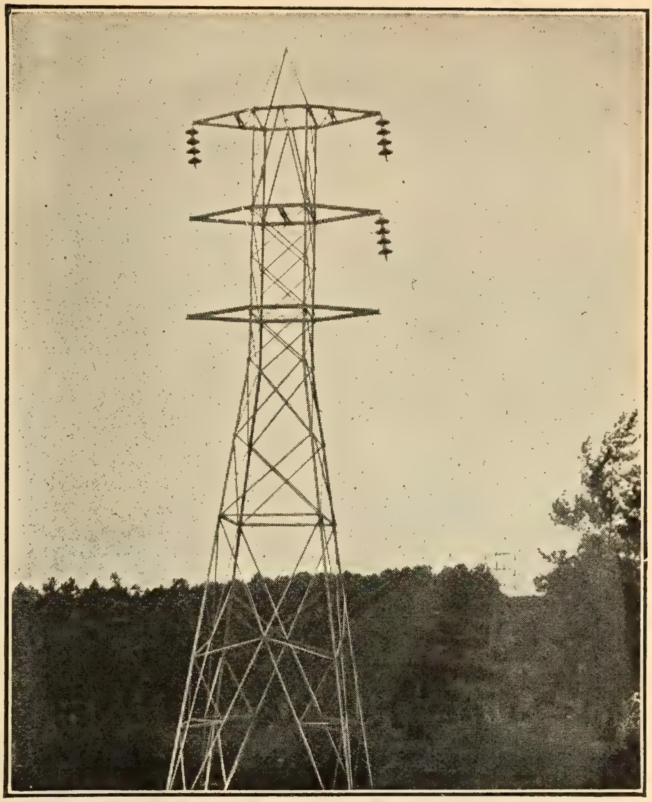
We said in a previous article that the case of "power *vs* the potato" proved that in an agricultural country water power was worth far more, used in irrigation than in making electric energy. But in mountainous countries, where forestry reigns supreme and agriculture is out of the question, are found hundreds and hundreds of rapids and waterfalls whose value can alone be realized by electricity and its high tension transmission. These sites can never be given over to agriculture, because the forests themselves are worth far more than the potato if properly managed, and are besides necessary for national existence. Switzerland, our own country, Italy, Norway, South America, and South Africa are full of such sites. During the last few years the growth of high-tension transmissions in the first three of these countries has been phenomenal. By



POWERHOUSE OF THE LUCERNE-ENGLEBERG TRANSMISSION LINE AT OBERMATT, SWITZERLAND

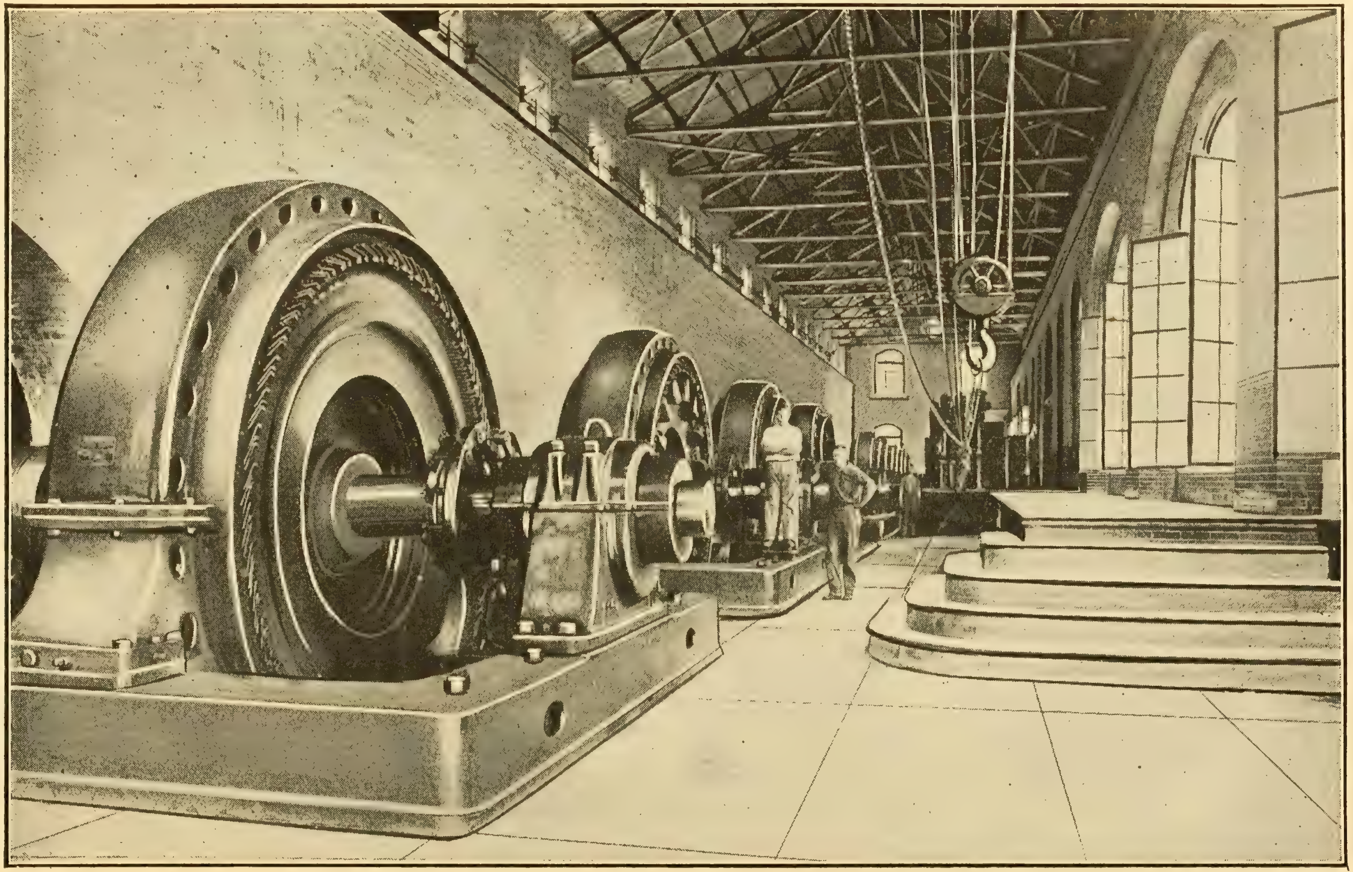
1900 there were numerous lines at from 20,000 to 30,000 volts; in 1904 there were literally hundreds at 30,000 and a few at 50,000 volts; and by 1909 in our own country alone there were five lines at 100,000 volts and even one at 135,000 volts, run from Au Sable river into Flint and Battle Creek, Michigan. In this we have considerably outstripped Europe, as the 88,000 volt line developing the Pescara river in Italy is their highest present voltage. Our own advances have been largely due to the courage and ability of our western and southern engineers, backed by the progressiveness of our great electric manufacturing concerns.

As to the national good high-tension transmission has done, let me cite just one instance. In 1904, the Southern Power Company started generating electricity on the Catawba river in South Carolina, within transmission distance of a hostile and indifferent cotton mill district. The electricity could hardly be given away, and it took lots of missionary work to get the mills to introduce electric motors in place of the old engine and shafting drive, in spite of the proved waste of 42 per cent of the engine's power by the shafting. Today, just six years later, that same company generates 98,000 kilowatts of energy, distributes it over a network of 900 miles of high-tension 50,000 and 100,000 volt lines to over 140 cotton mills, and the electric power is considered indispensable in that district which has boomed, to become the leading cotton manufacturing section of the South.


100,000-VOLT TRANSMISSION LINE TOWER

Perhaps the one thing that has done more than any other to make high tension transmission possible is the suspension insulator. No matter how large you make a pin insulator one half of it will always be wet in stormy weather and you cannot get enough air gap without an unwieldy construction. But if you construct an ordinary fourteen-inch insulator of, say, 80,000 volts' breakdown limit in wet weather and then hang another under it, you will have 160,000 volts insulation. Five of them, hung one below the other, will make a suspension insulator about four feet long and will have an ultimate breakdown of 400,000 volts which is a factor of safety of four on a 100,000 volt line.

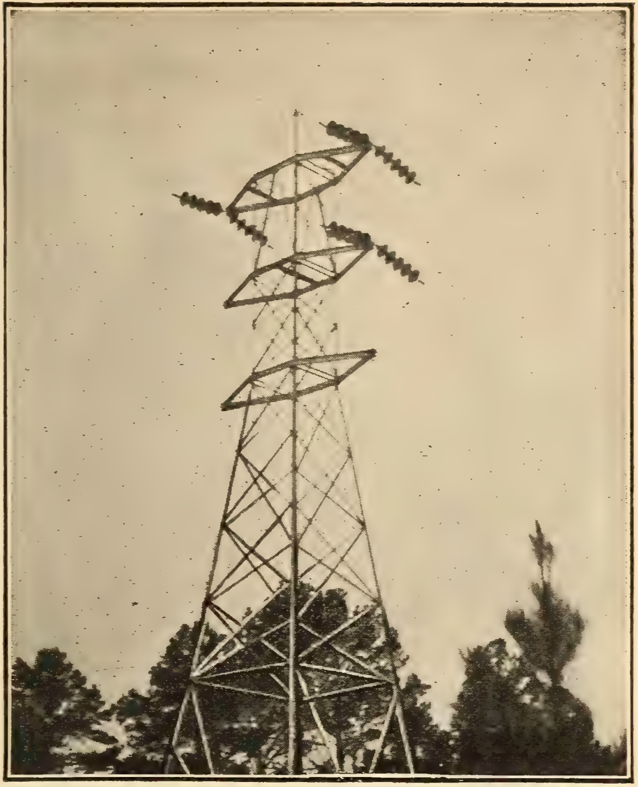
Another advantage—if you have a pin insulator line and a big tree falls across the line and breaks it, the whole strain of the lines will come on the pins of the adjacent poles. But if it is a suspension insulator line these will immediately fly out horizontally when the line breaks, and thus slack off the sag between poles of the adjacent spans. As the insulator is from four to four and one-half feet long, this slacking the line back about four feet takes out nearly all the strain in it, as anyone who has ever tightened up wire spans will easily realize. In suspension insulator lines every tenth pole is what is called a strain tower, to which the wires are anchored, the rest of the poles merely holding up the line. Here the insulators must necessarily stand out horizontally as they take the pull of the wire. There



INTERIOR OF THE GREAT HYDRO-ELECTRIC PLANT, GREAT FALLS, S. C.

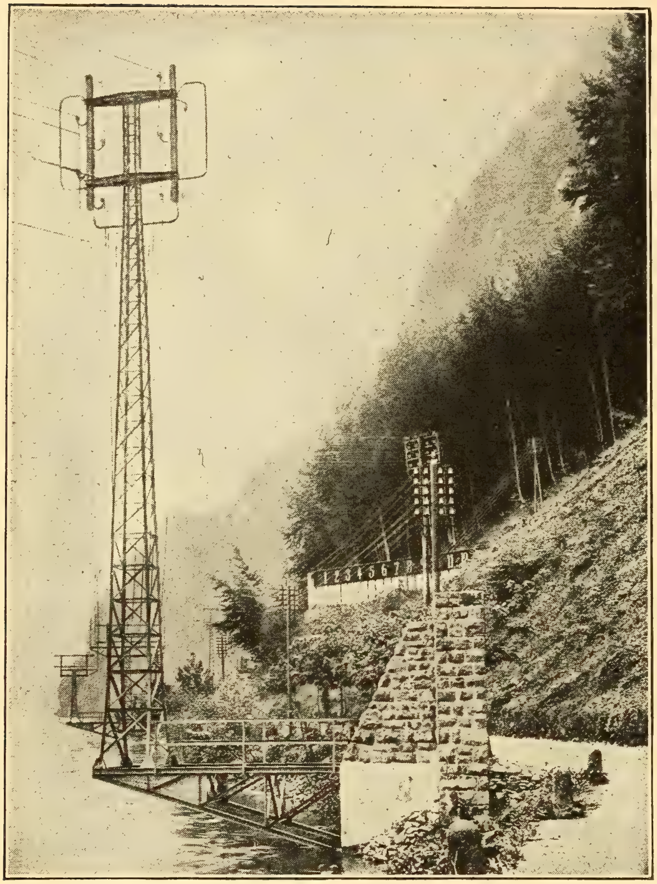
are therefore *ten* insulators in series instead of four or five, because the weather will wet at least half of them, no matter which way the wind blows.

The poles for these high tension lines are almost invariably high structural steel towers carrying the lowest wire 45 to 50 feet from the ground. Our illustrations show various types of them. The horizontal distance between conductors is fifteen feet and vertical distance about eight feet, which will give some idea of how great is the span of the 100,000 volt arc. As an instance of the various pole problems that come up, the high-tension line of the Lucerne-Engleberg transmission has a very interesting section passing along the base of the Loppergrat, an outlying spur of Mt. Pilatus. This spur is practically a sheer precipice 1,000 feet high with sharp terminal slopes of rock detritus at its base, with just room for a state road between it and Lake Lucerne. This steep slope continues down under the lake giving no location for piers out in the lake for the poles, and the only available right of way along the road is already usurped by a telegraph and telephone line. Standing on top of the Loppergrat you can peer down, it would seem, vertically upon the wagons a thousand feet below, but in reality there is considerable slope—enough to form large almost perpendicular fields of snow in winter. The avalanches in the spring off the Loppergrat are very frequent, and also an occasional boulder will start down the slope for no particular reason and ariive in the road with all the energy and velocity of a 13-inch shell. This cheerful combination of adverse conditions was met by the Swiss engineers by putting the poles out over the lake on cantilever struts, as will be seen on the next page. These are anchored into massive stone and concrete piers which not only resist the turning movement of the cantilever but also protect the pole from flying boulders and avalanches.



100,000 VOLT TRANSMISSION LINE STRAIN TOWER

In our own country the high-tension lines go over hill and valley, for the most part forested, and the slopes of the mountains are by no means the even grades one would imagine, being full of ravines and ridges. The spans run from 400 to 600 feet with occasional long spans of as much as 1,400 feet. Working over this rough country introduces many a line construction problem. It is important to distribute the static load, *i. e.*, the weight of the wire, equally on all the towers, and to do this the sag should be uniform between them. Now suppose when the wire is pulled up to its proper sag, you find the pole down in a ravine four feet below the wire. You cannot alter the sag as that would throw uneven loads on the other towers, nor can you tie the line down onto the pin because it is a suspension insulator and the wire must hang from *it*. Therefore the pole must be moved, and to avoid doing this frequently in mountainous country the lines have to be carefully surveyed and profiled and the sags accurately calculated.



CANTILEVER TOWERS ALONG LAKE LUCERNE UNDER THE LOPPERGRAT

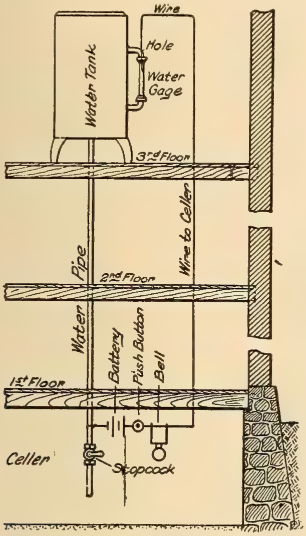
In getting up to 135,000 volts on the Cook-Flint line another problem, that of the corona or atmospheric leakage of this high tension line, had to be studied for probable line losses. Based upon the experience of this company with the 110,000 volt transmission line to Grand Rapids this corona loss would not exceed one kilowatt a mile for No. 0 wires at 135,000 volts. The computation data were gotten by raising the Grand Rapids line temporarily to 125,000 volts and noting the brush display and corona loss for the No. 2 wire of that line. This 135,000 volt line feeds Flint, Saginaw, Bay City and all the towns in that part of Michigan with their large manufacturing interests. It is a curious fact that the lightning and thunder strokes, which give so much trouble with the lower voltage lines of 30,000 to 50,000 volts, have been less difficult to manage during severe thunder storms on the 100,000 to 135,000 volt lines. The electrostatic conditions, up hill and down dale, vary all along transmission lines with the passage of heavily charged clouds, etc., and every static disturbance gives rise to abnormal potentials and frequencies. The lower voltage lines have less insulation to ground, so that a lightning stroke can break through somewhere and establish a destructive arc, instead of going to ground through the line or station lightning arresters. With the high-tension lines the better insulation forces the lightning charge to stay on the wire and depart by the proper arresters, which are designed to take care of the violence of the discharge without disaster. "Lightning" means much more than the visible flash seen during electrical storms. It includes also surges of current due to static charging during a storm and the existence of varying conditions of temperature and weather over the entire system, which may stretch 150 miles across valleys and mountain ranges. Although some of these high-tension 100,000 volt lines have been run without any protection except that at central station and sub-stations, lightning arresters are essential features at frequent points along the line for lower voltages.

As to the future of high tension transmission, the distance that power can be sent is simply a matter of wire and insulation. The suspension insulator seems to be as capable of use on 200,000 volts as on 135,000. The limit will probably be set by the atmospheric corona loss over the whole line, but it is impossible to predict *anything* in electricity. Actual trial of a 200,000 volt line may develop new scientific discoveries that will prove the 200,000 volt line as much superior in practice to the 100,000 volt as the latter is to the 30,000 volt transmission.

(The end)

"Enough Water" Signal

This drawing shows how I have saved myself many steps in taking care of a hot water system. To fill the water tank the stop-cock in the basement is used. As soon as the water in the gauge glass rises high enough to touch the end of the wire running into the glass at the top, the bell in the basement will ring whenever the circuit is closed by the push button near the stop-cock. The small hole for the wire through the gauge glass pipe I closed up with sealing wax.



WATER TANK ALARM

—WM. J. HOLMES.

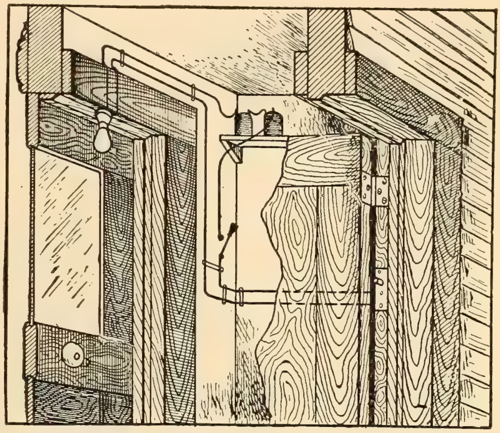
Hints on Caring for Gravity Cells

The following hint regarding the care of the gravity cell has enabled me to get better service out of it and to keep it cleaner: Allow at least one inch from the surface of the liquid to the top of the jar and pour over this surface plenty of paraffine. If enough of this is not obtainable, use common clear machine oil over the liquid, dipping only the top of the jar into paraffine. This plan prevents evaporation and stops the creeping of sulphate over the top of the jar.

—JOE N. BANKER.

Lighting the Way In

It is most convenient to be able to find the door-bell push-button, the keyhole or the door-knob on a dark night. An arrangement for doing this is here illustrated. In the casing of the storm-door or outer door to the hall an automatic door-switch may be installed and connected as shown. When the outer door is opened, the switch closes the circuit and lights a small, low-voltage lamp placed at any desired location about the inner door. Closing the outer door causes the door-switch to turn off the light. The switch may be purchased of any electrical supply house or made in the form of a push-button and set in the casing. Two dry cells connected in series will light a one-candlepower, three-volt, tungsten, battery-lamp which will do very satisfactory service.



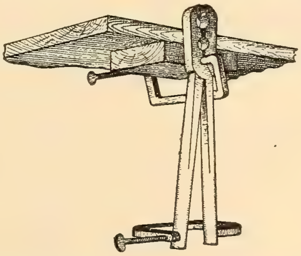
VESTIBULE LIGHT

—MISS R. E. MATTHEWS.

Making a Vise

A handy substitute for a vise to hold metal conduit may be made as shown in the accompanying sketch.

Under the edge of the bench securely nail a block of wood 2 by 1 by 3 inches. By means of a screw clamp fasten a plumber's wrench to this block. The jaws of the wrench can be made to close tightly by applying a screw clamp near the ends of the handle.

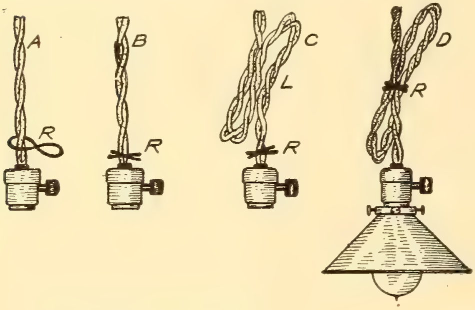


SIMPLE VISE FOR METAL CONDUIT

—FRANCIS B. COYLE.

Cord Adjuster from a Rubber Band

An ordinary rubber band such as is used to hold a bundle of folded papers together makes a very handy cord adjuster to vary the height of a drop light. The illustration explains how to put on the band, which, being soft and pliant, does not wear the insulation of the cord.



SIMPLE WAY TO ADJUST LAMP CORDS

—Clyde Mertz.

Changing Small Battery Motor to Induction Type

Any one who has been operating his small battery motor on low voltage alternating current can easily convert it into a perfect induction motor. The motor I have found most suitable for the purpose is the small three-pole armature type. Fig. 1 shows the connections of such a series wound motor for operating in series with three sixteen candle-power lamps in multiple.

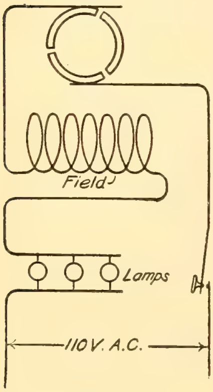


FIG. 1

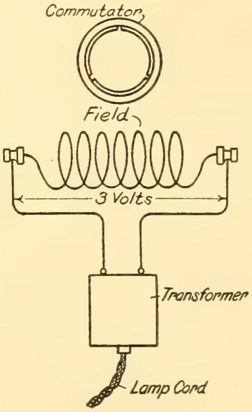


FIG. 2

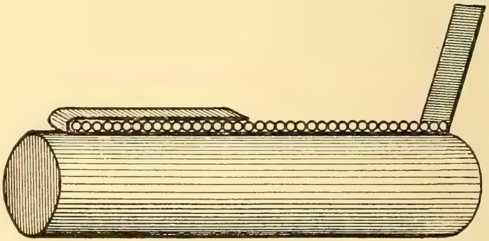
To change the motor to the induction type take the brushes and brush holders off. Connect up the field so that current will flow through the field only, as clearly indicated in Fig. 2.

Now carefully wrap a few turns of small copper wire around the commutator, apply the current, give the motor a turn and it will climb up to speed. It will run in either direction depending upon the direction in which it is started. A very neat trick is turned by stuffing small bits of tinfoil in the segments of the commutator and using no wire.

—C. V. V. Turner.

Magnet Coils Without End Disks

If the space available lengthwise of the core in a magnet is limited, a magnet coil may be made without the usual spool or even the fibre end disks by using tape to hold the wires in place. To do this, the first layer of wire is wound over three or four narrow pieces of tape laid lengthwise of the core, each piece being of such width that together they cover the upper surface of the core.

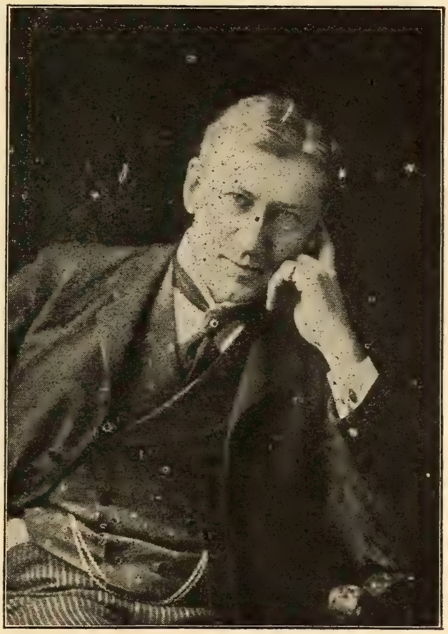


METHOD OF WINDING MAGNET COIL

When the first layer of wire has been wound over the strips of tape (each of which should be twice as long as the intended coil) the two ends of the tape are doubled back over the winding and fastened in place by the stickiness of the tape itself. Or if an unsaturated tape is used, a coat of shellac over the wire before the tape is doubled over will hold the latter in place. Then another series of tapes of the same length but slightly wider, so as to allow for the increasing circumference of the center, is started over the other. By building up in this manner it will be found that the successive layers of the coil will be bound together firmly.

Electrical Men of the Times

CHARLES S. BRADLEY

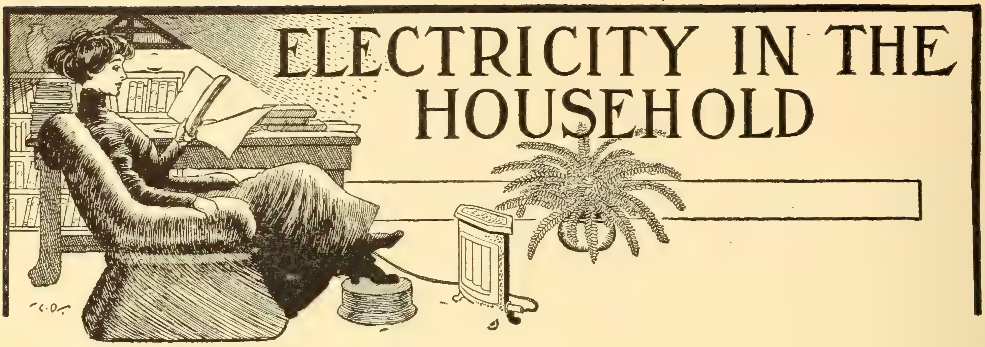


A man who has made a deep impress on many electrical arts is Charles Schenck Bradley, who was born at Victor, New York, on April 12, 1853, of old English and Dutch stock. After receiving a grammar school and collegiate education, Mr. Bradley became associated with Thomas A. Edison in 1880, and for three strenuous years aided in the early development of the Edison system. Being very fertile, however, in ideas and inventions of his own, he created a personal laboratory, from which came in rapid succession a long series of valuable patents and apparatus. Foremost among these, perhaps, were ones relating to the polyphase alternating current, now in such universal use; while one of the patents embodies the basic principle of the modern rotary converter by means of which alternating current is changed at will for use as direct; or vice versa. Very early, Mr. Bradley, turned his attention to electro-chemistry and electro-metallurgy and this brought him to the production of aluminum by processes which gave the world cheap and abundant supplies of the new metal. Next in line came his brilliant work in electrically "fixing" nitrogen from the atmosphere, to take the place of the nitrate deposits of Chili and of the phosphate beds of the southern states. His plant at Niagara attracted world wide attention at the beginning of the century. More latterly, Mr. Bradley has been engaged in the chemical extraction of copper, by methods corresponding to the cyanide process of gold extraction. In this field, where enormous economies can be effected, Mr. Bradley has done a wonderful amount of ingenious and successful work.

All this, however, does not fully detail his results, nor has it exhausted his energies. For example, over 20 years ago he invented and patented automobiles in which the current to drive the motor is generated by a small gasoline engine plant on the car itself, as now seen in practice with prospects of large development. Another patent covers the first continuous electric furnace for the production of calcium carbide, yielding acetylene gas, the process being used in the largest plants for carbide production. Other inventions relate to transformers, telegraphs, electrical condensers, measuring instruments, power transmission, liquid air, reduction of iron, etc.

Mr. Bradley is a man of unbounded originality, and touches nothing he does not improve, while, as will be seen from the above he has done highly creative work in many arts.

It might also be added that during his life, he has necessarily been connected with various companies, by some of which he has been substantially aided in his work; but he is essentially one to push his own way forward into the new domains of discovery, and he has ever been ready to exploit a new art with the reward won in developing an earlier one. An interesting fact is that of late years he has enjoyed the active assistance and co-operation of two sons, to whom he confides details of finance and engineering, thus leaving himself free for purely inventive work.



ELECTRICITY IN THE HOUSEHOLD

Where Art and Science Meet

By T. VERNETTE MORSE

In the old colonial days when the capable housewife was not only mistress of the home, but, from the raw material, produced nearly everything required in that home, she did not make much of a stir in the scientific world. As a matter of course she mixed the proper ingredients for those delicious breads and cakes, she managed in some way to dye the cottons and wools which she spun, wove and afterwards manufactured into garments for her family to wear. She had a way of preserving fruits and vegetables when they were plenty, that they might form part of the family menu during the long, cold winters. Her spare moments—we wonder where they came from—were devoted to embroidery, painting and the thousand-and-one little things that express so clearly the æsthetic nature of woman.

Day after day those noble women planned and executed that their families might enjoy the comforts and luxuries of life. But no one ever suggested that they were scientific or artistic.

The kitchen was the laboratory and central force of their activities. Each member of the family was an essential element in that small, manufacturing home world.

To follow the history of the kitchen from those early colonial days is to follow the evolution of all great American industries.

Our grandmothers said, "Give me a well-supplied kitchen, and I will produce everything needed in the home." But the whirl of machinery and combined manufacturing interests have changed those conditions, until we of the present demand a kitchen so revolutionized by scientific invention that it is only necessary to "touch the button" in order to supply the modern home with everything needful.

When the great universities and colleges first opened their doors to admit women, they took from the home those who were most progressive, women who had a desire to express intelligently and professionally the great scientific problems of life. Years were consumed in the study of technique, the diploma was earned, and the brilliant scholar returned to the home, but was no longer a part of it.

Her knowledge of technique had, for the time being, carried her beyond the problems which she had so clearly and sensibly solved before technique and analysis became the all-absorbing topics of her life. She had returned a specialist, instead of a general.

In the meantime the machine-made world had not been idle, and the homely occupations of the home were slowly but surely giving away to methods and processes developed by factory-made utensils.

The home-producers became the consumers and women were emancipated from the drudgery of housework.

Then it was that woman's true nature asserted itself. The college woman with her oft-derided "isms" came loyally to the rescue; again she became a general but in what a different manner. With her enlarged outlook, she understood her true worth and her importance as a companion to her husband and family.

She immediately marshaled her new forces, and applied their principles again to the every-day problems of housekeeping, meeting the new conditions with a better knowledge of the situation, but with the same gracious assurance that her grandmother had met those of her time.

The modern woman has learned to select as her burden-bearers those inventions that will best lighten the labor of each day.

You may say if you will that it is the men who have designed, experimented with and developed electric cooking-utensils as they are used today. But the burden of selection of the things which are essential and practical has fallen on the women, and to them should be given the credit of separating the wheat from the chaff. The product of great inventors must eventually pass the test of her judgment. Those things which she has finally accepted have been made her servants, all helping to make the home a center of culture and refinement. She returns to the "simple life" by the direct route of advanced science.

Electricity may not be as sentimental or as picturesque as some of the "pictures that hang on memory's walls," but it is far more cleanly, economical and labor-saving. It gives greater returns for the time and labor expended.

The small space required for the electric range, its absolute cleanliness, and perfect results, makes it especially adaptable to the cottage home. The different kinds of heat required in cooking may be obtained at a moment's notice. It is always ready, there is no dust, no smoke, nothing disagreeable.

The writer has in mind an electrical kitchen, a small room just off from the dining-room. It is so planned with closed cabinets and convenient shelves that a butler's pantry is as unnecessary as the butler. In this cosy home the housewife reigns supreme, yet has leisure for her social life.

There is little else to do aside from preparing the foods, which is done on a long, white table under the window. As soon as the foods are prepared the meat is placed in the broiler or oven, as the case may be, the vegetables are cooking on the different disks, the soup and dessert are in the fireless cooker, and the coffee sends forth an appetizing aroma from the electric percolator. If you have never used an electric percolator, you have missed one of the great treats of modern life.

The electric fireless cooker may be the cultured cousin of the old-time "hay-stove," for it is a combined stove and fireless cooker.

The foods are prepared and placed in the cooker, the current turned on long enough to partly cook them, then, without disturbing them in the least the current is turned off and the stove becomes a practical fireless cooker.

In this new kitchen the ventilation may be controlled by electric fans or blowers and not the slightest odor of cooking penetrates beyond the range.

Possibly the one convenience which appeals most forcibly to housekeepers is the electric dishwasher, for it does its work perfectly with never a growl nor grumble.

The dishes are placed in position in the cabinet, the current turned on, the hot water thus loosened leaps and sparkles with joyous motion, until those "horrid dishes" are once more bright and clean.

The electric kitchen in white enamel, furnished with modern electrical appliances, has solved the servant-problem, and given to housekeeping a new and enlightened interest.

There are few women who do not like housekeeping. What they dislike is its complications, and incessant repetition. Electricity has entered the field as first assistant to all demands and will, if properly guided, open the doorway of a new and attractive home life wherein the ideal woman may reign supreme without detracting from her intellectual and artistic development

The kitchen will again become the unit of activities, but this time it will be based upon the combined forces of art and science and will give to the creative mind a wide field for individual development.

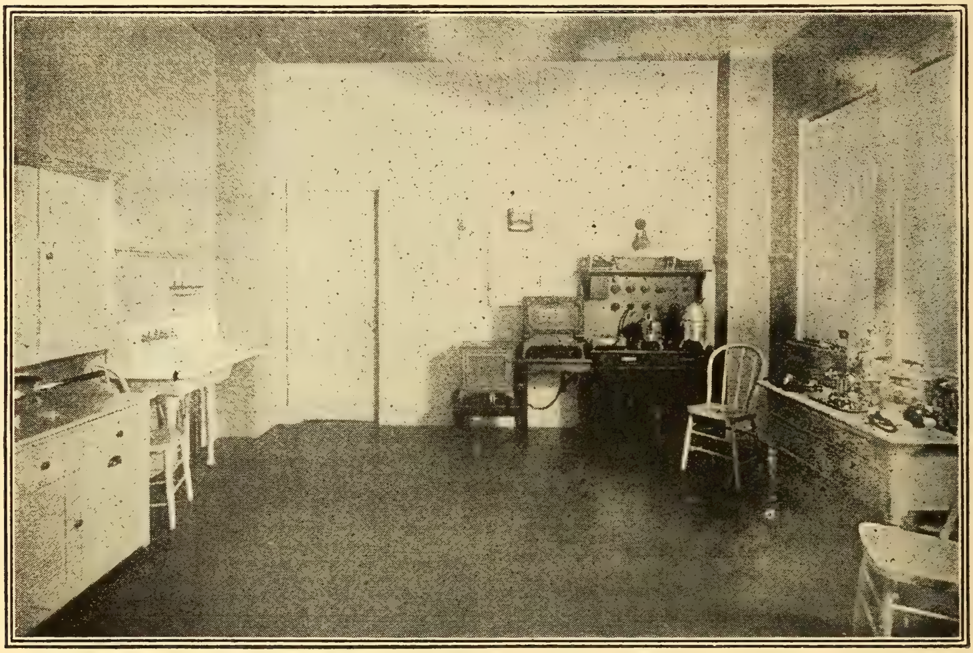
The House Without a Chimney

By VARNEY V. SHUMAKER

An unusual exhibit was opened to the public on Thursday evening, October 27, by the Seattle Electric Company. It consists of a four room cottage with bath, equipped throughout for lighting, heating and cooking by electricity. The exhibit has very appropriately been called by its designer, Manager W. J. Grambs, "The House Without a Chimney."

The company has recently completed a large office building at the corner of Seventh Avenue and Olive Street, Seattle, and a depth of twelve feet, extending the whole width of the building is occupied by this model house interior.

Previous to the opening many thousands of invitations had been sent out to the friends and patrons of the company and a cordial invitation extended through the papers to the public in general as well, to attend a reception in the model home. As variously estimated, from five to seven thousand attended the reception. The entrance to the building was attractively decorated for the occasion, the doors being flanked by huge laurels in tubs, and suspended above the entrance the triskelion, the emblem of the company, was displayed in electric lights. Inside the hall there were other potted palms, Japanese spruce, and huge unnamable plants from park greenhouses. In the various rooms ferns and cut flowers were tastefully arranged. Across the hall in the contract department an orchestra was stationed and here refreshments were served. All of the dainty dishes which delighted the guests were served direct from the model kitchen where they had been prepared upon its electric range.

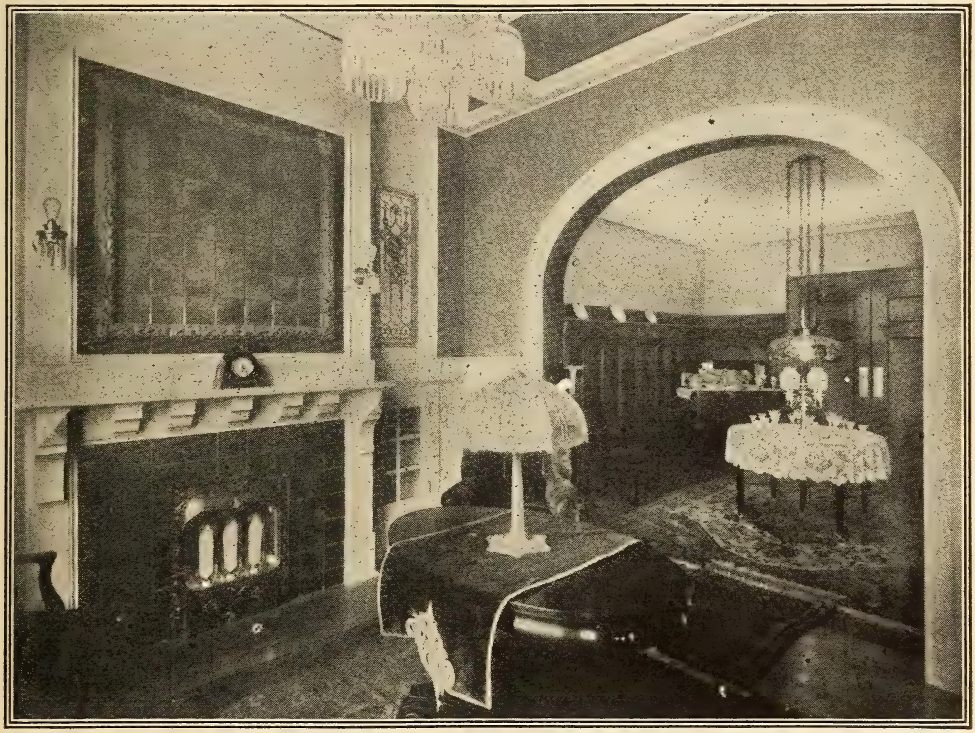


MODEL KITCHEN IN THE HOUSE WITHOUT A CHIMNEY

During the evening the greatest interest was manifested in the model house which may possibly mark the beginning of a new epoch in the building of dwellings—the age of the chimneyless home free from smoke, ashes and their attending dust. No pains nor expense were spared in the appointment of this little flat.

The drawing room is finished in ivory

enamel with a wall decoration in flat gold while the upholstering, hangings, and a beautiful Boccaro rug blend harmoniously in a soft brown. The fireplace is equipped with an electric radiator of three 250-watt lamps having their heating elements arranged so as to give three different degrees of heat, low, medium and high. This radiator will very comfortably heat this room in the coldest weather and lends a "comfy" appearance by giving forth the cheerful glow of an open fireplace. The lighting is by a "shower" chandelier and by brackets on the fireplace decorated with prisms. On the centertable is also a large portable lamp with an elegant leaded glass shade.



DRAWING ROOM AND DINING ROOM IN THE HOUSE WITHOUT A CHIMNEY

The dining room is finished in beautiful Philippine mahogany, to the height of six feet, surmounted by a plate rail. The floor is of hard wood and in the center is a royal Khiva rug. The lighting here is by the direct-indirect method, a row of 40-watt lamps being placed around the border of the ceiling concealed from view but reflecting the light from the plaster of Paris ceiling. Over the table is suspended a beautiful leaded glass dome. An electric heater warms the room and for keeping side dishes warm or for preparing light lunches electric chafing dishes may be found on the sideboard nearby.

But the equipment most fitted for making housekeeping a pleasure and for freeing it from all inconveniences is to be found in the model kitchen. Here every auxiliary to domestic economy may be found. The kitchen cabinet, table, chair, and kitchen itself are all finished in white enamel. At one side is a porcelain sink with hot and cold water connections—the water being heated by an electric heater. Among the cooking utensils may be found every device for the convenience of this department foremost among which is a large electric range suitable for every kind of baking. The range is equipped with switches for regulating the heat to any desired temperature, low, medium or extremely high. There are also a teakettle, toasters, a grid for broiling, waffle irons, frying pans, coffee percolators, double boilers for cereals, all electrically equipped for fast or slow heating.

The bath is connected with both kitchen and bedroom. It is finished in white enamel, and furnished with a specially lighted shaving mirror, a small water heater for use in shaving, a foot warmer, and a tiny radiator. The water for the bath is heated by a large electric heater.

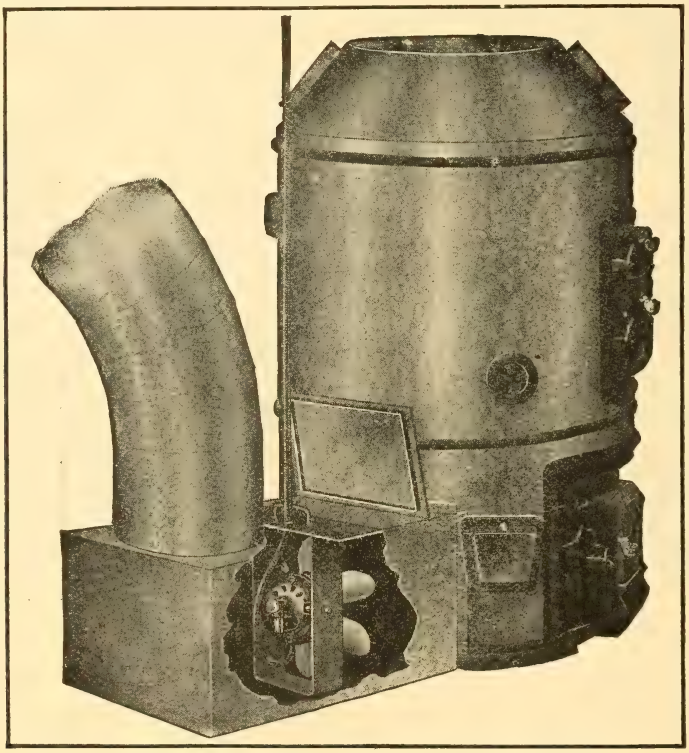
The bedroom is quite in keeping in its elaborateness with the rest of the cottage. It is furnished with a heavy brass bedstead with a handsome bedroll and covering of embroidered lace. A princess dresser, chairs stand and table are in white enamel, the room in pearl grey with a slight touch of rose. From the ceiling hangs a beautiful lamp with brown silk shade, while near the bed is a reading lamp adjustable to different heights and to any position. Every appliance for the toilet is provided, electric curling irons, electric vibrators, hair dryers with hot and cold blast, warming pad, water heater and the indispensable electric radiator.

In the general display room, which it is necessary to cross after leaving "The House Without a Chimney," have been arranged many other devices which would not harmonize with the idea of the model cottage, all of which have their place in lightening the burdens of housekeeping.

Fan Motor to Reduce Fuel Bills

The usefulness of the fan motor is by no means confined to the hot days of summer, and that, paradoxical as it may seem, the electric fan blows hot and cold; and incidentally while it is blowing hot it cuts the fuel bill.

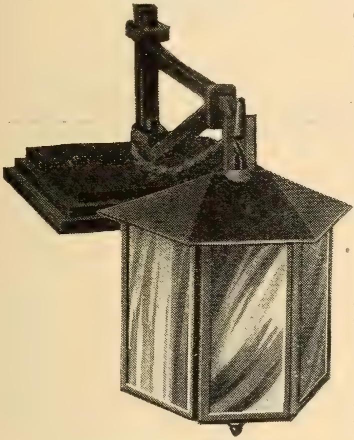
The efficiency of the hot-air heating-system may be greatly increased by placing a fan motor in the cold-air box to force the air through the registers to all parts of the house. On particularly cold days when the wind is so strong that it forces the air through the furnace into the rooms without having become heated, a fan motor placed in the cold-air box, after having closed the slide which permits air to come in from the outside, and opening the slide which lets the air in from the cellar, will cause an appreciable rise in the temperature of the room, without making any increase in fuel consumption.



MAKING THE FAN MOTOR WORK IN WINTER

Artistic Piano Lamp

In this age of bungalows, dens and home conveniences, interior decoration is receiving more consideration. Something out of the ordinary is the Federal piano lamp constructed of metal and art glass in the style of an old lantern, the metal portions being finished in dull black. For lighting the music, screening the eyes and at the same time adding to the attractiveness of the piano corner it deserves consideration.

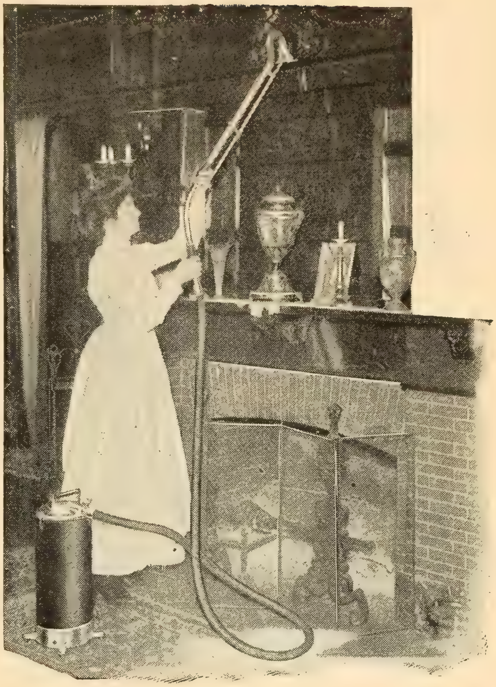

ARTISTIC PIANO LAMP

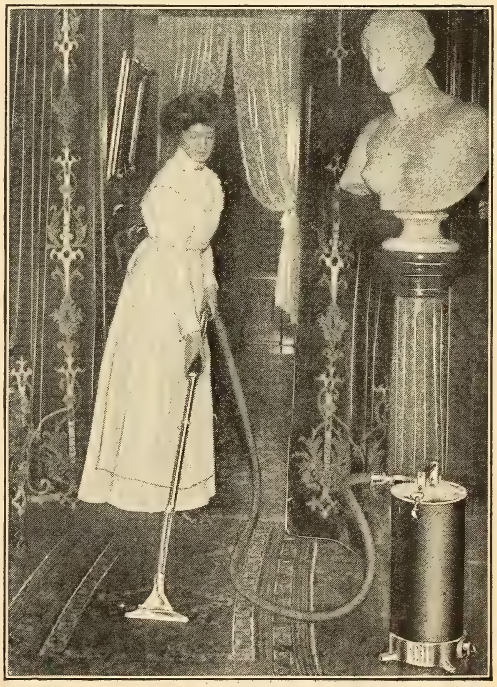
A New Portable Vacuum Cleaner

The advantages of vacuum cleaning have been pointed out a great many times in this department. Not all the different types of electric vacuum cleaners have yet been shown, however, among the newcomers in the field being that of the BirtmanElectric Company. A few words about this "truly portable" type, will not be out of place:

The machine, complete, weighs only 20 pounds. It operates upon either direct or alternating current circuits, and at a cost within two cents an hour. There are a number of different "tools" or nozzles to be connected to the flexible hose, which are adapted to cleaning curtains, carpets, upholstery, radiators, tufted furniture moldings, bedding, etc., in fact, any place where dust can accumulate. It is arranged to blow air out through the nozzle as well as draw it in by suction, thereby acting as a compact compressed-air system.

A new feature is the adjustable handle which is shown in one of the illustrations. This is made in two parts, with a special flexible joint between. This adapts the nozzle for working over pictures, moldings, door frames, under beds and in otherwise inaccessible places.


ATTACHMENT FOR CLEANING MOULDINGS


DUSTLESS "SWEEPING"

JUNIOR SECTION

Construction of Small Motors and Dynamos

By CHAS. F. FRAASA, JR.

CHAPTER II.—FIELD MAGNETS

Having described the construction of the boring machine and drill press in the preceding chapter, we will now take up in detail the construction of a small direct current dynamo or motor, of given capacity. A dynamo or motor consists of the following essential parts: The field magnet, armature, commutator or collector, brushes and brush holders, and the windings and connections. The functions of each part may be learned from any book on this subject and will not be given here, for this article will deal only with the construction. It should be said, however, that the whole is so dependent upon each part for good operation that careful attention must be paid both to construction and assembling

FIELD MAGNET

The field magnet is one of the most important parts of the dynamo or motor, and one of the hardest to construct properly. For convenience, we will designate the parts of the field magnet referring to Fig. 8: The pole pieces (H); the magnet cores (I); and the yoke (J). The pole pieces (H) partly surround a cylindrical air-space which is between them, known as the polar bore, in which the armature rotates. Between the armature and pole pieces there is a slight clearance known as the air-gap. This air-gap is equal roughly to one-half of the difference between the diameters of the armature and the polar bore.

It might be well here to enumerate certain features of construction which are desired in nearly all small machines. The shape and type of field magnet depend upon the conditions under which the machine must operate, and the facilities for constructing it. The number of poles or pole-faces depends upon the number of commutator segments, and the voltage under which the machine must operate. The number of poles must not be too great, for with ordinary armature windings the number of brushes and brush holders must then be unnecessarily increased, cutting down the number of intervening insulations between the commutator segments per pair of poles, and consequently the number between brushes, leaving them so few, that poor commutation and disastrous sparking results. The permissible number of poles may be determined by

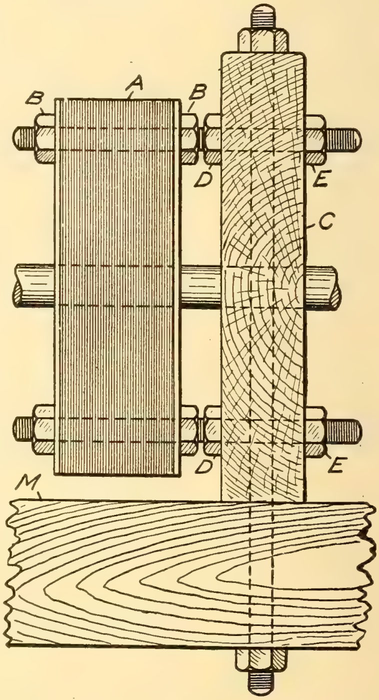


FIG. 7. BEARING BLOCK AND WORK HOLDER

dividing the voltage of the machine by ten, which gives the number of necessary insulations between brushes, and by dividing the number of insulations in the commutator by the result. This is based upon an allowance of ten volts per insulation on the commutator.

In order to maintain the efficiency, the air-gap must be short, as a large magnetizing force is necessary to push magnetic lines through even a comparatively short air-gap. The length of the air-gap should be somewhere between 1/16 and 1/32 inch.

There also exists a general ratio between the length and diameter of the field bore of standard models based upon this same ratio in dimensions of the armature. For field-magnets of dynamos and motors having a toothed armature core, the diameter should be equal to the length for two-pole fields; for four-pole fields, the diameter should be twice the length; and for six-pole fields, three times the length.

The percentage of the armature bore covered by the pole pieces varies from 50 to 75 or 80 per cent but can be considerably less. The greater the per cent of armature covered, the greater will be the output which a given machine will generate, provided the field core sectional area is correspondingly increased.

Another factor in the design of field magnets is the magnetic circuit. Field magnets are usually made of cast iron, wrought iron, steel, or sheet iron. Of these, the first three are capable of retaining magnetism after the field magnetizing current ceases to flow. This retained magnetism is known as residual magnetism. In a motor, the fields are magnetized by the line current, therefore any one of the four may be used in the construction of its field magnets. But in the case of the dynamo is it different, unless the field is excited separately (magnetized by a current external to its armature circuit), the self-excited dynamo depending upon the residual magnetism for its start in generating. Upon rotating the armature, this magnetism causes a current to be generated in the armature, and this current in turn passing through the field coils increases the magnetism until it has been built up to a certain density or to saturation depending on the ampere-turns in the field coils. From this it will be clear that of the four designs, the first three may be used in the construction of a direct current field magnet, sheet iron being useless for this purpose. However, by bolting cast iron, wrought iron or steel plates on the sides of the sheet-iron fields these may be made to retain a certain amount of magnetism. An example of this will be given in the construction of the following designs, all of which have sheet iron field magnets. For motors, for reasons previously stated, the field magnet may be constructed entirely of sheet iron; but if a dynamo field is to be so built, it should have cast or wrought iron plates bolted to it.

The wrought iron plates for this purpose may be obtained by cutting open a piece of iron pipe of such a size as will give a sheet of the required dimensions, when flattened out. Flatten while red hot. I have successfully made many plates in this way, by cutting a piece of pipe into two parts with a hack saw, and heating the resulting parts in a cook stove; then by holding them in a monkey wrench upon the head of an ax for an anvil, have beaten them flat with an ordinary hammer.

The cheapest form of sheet iron for use in the field magnet may be obtained by melting the solder off of tin cans, cutting them open and then beating them flat into sheets. They may be cleaned with sand paper if desired, but I have never found this necessary This tin-can iron will give very good results. I have had it give as good results as sheet iron I have purchased. But to be sure of good results and neat work a good grade of sheet iron should be used. Stove pipe iron, which is very satisfactory, may be obtained from the hardware store, but the blue iron of which the tinner makes pipe is cheaper and just as good.

These machines are designed for four given capacities, which we will designate by the four letters (A), (B), (C), and (D). Machine (A) will generate an output of 50 watts; (B), 100 watts; (C), 300 watts; and (D), 800 watts. These ratings are at 1,500 revolutions per minute. When run as motors (A) will have an output of about 1-16 horsepower; (B), $\frac{1}{8}$ horsepower; (C), $\frac{1}{2}$ horsepower, and (D), one horsepower.

Though the standard speed of these machines is 1,500 revolutions per minute, by driving at a speed of 2,500 revolutions per minute, the outputs will be: (A), 100 watts; (B), 225 watts; (C), 500 watts, when wound for this.

These models when built to operate as alternating current generators, double-current generators, or as rotary converters, should be run at a speed of 1,800 revolutions per minute, to get the standard frequency of 60 cycles, and to get the full rated output. The field for the alternating current dynamo will require four poles as in Fig. 9, and must be excited by direct current led from a commutator provided for this purpose.

The fields of these models are of two general types, the two-pole, and the four-pole. The two-pole field, for reasons given above is to be preferred, since the sparking will be less than with the four-pole field, but the four-pole field must be used for the alternating current generators. The two-pole field covers 75 per cent of the armature, or each pole covers an arc of 135°; the four-pole, 80 per cent, or an arc of 72° per pole.

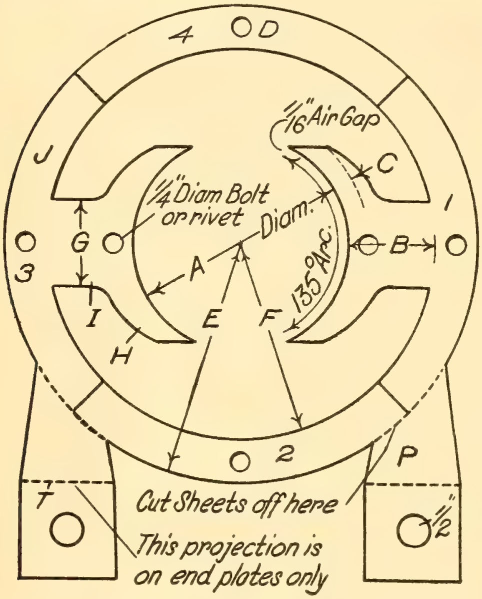


FIG. 8. FRAME OF TWO-POLE DYNAMO OR MOTOR

Upon reading the dimensions of the field bore, next page, the reader will notice that those for the four-pole field do not comply with the data given above. It is necessary in these designs to keep the dimensions diameter equal to length, in the polar bore, in order to keep the diameter of boring within the limits of the boring machine.

For the alternating current machines there will be a few changes in the dimensions, as follows:

Dimension (G) in (A), will be 7/10 inch; in (B), 8/10 inch; in (C), 1 inch, in (D), 1⅜ inches. The yoke or rim thickness for (A) will be ½ inch; for (B), ½ inch; for (C), ¾ inch; for (D) ¾ inch. The thickness of the stack of sheets for both the alternating and direct current machines should be: (A), 3¼ inches; (B), 3½ inches; (C), 4¼ inches; (D), 5 inches.

To better explain the construction of these models, we will from here on take up the construction of the 50-watt size in particular, as the building of this is as difficult as any to design because of having to build a very small machine for a high voltage. For the dynamo field magnet four wrought iron plates will be required, two on each side of the stack of sheet iron, though twice this number would be preferable. The wrought iron and the sheet iron should be cut to 8½ by 10 inches. Cut V-notches in the two ends of one of the sheets, and using this sheet as a pattern, cut notches in the ends of all the sheets. Then drill holes in the ends of the plates corresponding to the notches in the sheets, and after placing half of the wrought iron plates upon either side of the sheets, pass one-fourth inch bolts through the holes in the plates and the notches in the sheets, and clamp the whole tightly by tightening up the nuts. This serves to clamp the whole and hold it so that it can be handled as one solid mass, and will not allow the sheets to slip or turn.

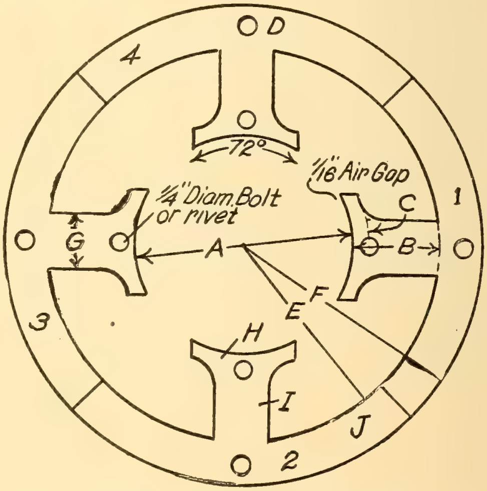


FIG. 9. FRAME OF FOUR-POLE DYNAMO OR MOTOR

Now describe a circle of 3 7/16 inches radius, divide this into four parts by two lines perpendicular to each other passing through the center of the circle. Drill ¼-inch holes at the intersection of these lines with the circle. These holes are for the bolts which hold the field together, support it while boring, and later hold the bearings.

Next take the bolts from the iron and trace the pattern on one of the sheets. Cut out along the lines and use as a pattern to cut the rest. Two of these patterns will have to be made, each being cut into two segments. Pattern No. 1 will be composed of two segments; segment 1 being (1) and (2) in Fig. 9, and segment 2 being (3) and (4). In pattern No. 2, segment 1 is composed of (1) and (4); segment 2, of (2) and (3). When these segments are stacked in this way, the joints will be staggered and there will be a good magnetic circuit. It is necessary to cut the field in this way in order to cut out the pole-pieces. Now put four bolts through the four holes in one of the end plates, and lay the plate with the bolts up; on this place one of the sheets with the bolts through the holes in it, and on this the pattern, and trace around and remove. Then cut out the field along the lines with the tin shears. Continue this until all are cut.

The patterns should be traced around the plates in the same way (they should not be cut in segments) and cut out with a file, hack saw and a cold chisel.

When all the sheets and plates are cut, they should be assembled in such a manner that all the joints are staggered, and the field bolts passed through the four holes. This may be done by assembling the sheets on the bolts passed through the holes in the end plates. When assembled the stack should be 3⅜ inches thick, and half the end-plates should be on either side. The field is now ready for boring. All preparations for boring should be made carefully to get good results. Set the boring tool in the tool holder of the boring machine at a point such that it will cut a circle of 3 7/16 inches radius, and inscribe a light circle upon the bearing block (C), shown in Fig. 1, Chapter I. Divide this circle into four equal parts, and then drill four equally spaced holes, ¼ inch in diameter at these points. The bolts (a) Fig. 7 (the field magnet bolts) should be threaded as shown in the figure, and be secured by the nuts (B), the nuts (D) screwed on, and then put through the holes in the block (C). Then screw on the remaining nuts, and tighten all until the field is securely fastened to the boring machine block (C).

Now set the boring tool upon rotating the shaft so that it will cut a circle 3⅜ inches in diameter. The tool for this purpose is the side cutting tool shown in Fig. 4. Now feed up the device by turning up the nuts (H), until the tool touches the field in at least one place. Then adjust the nuts at each bolt till the tool touches at all points when revolved. This will make the bore perpendicular to the face of the field magnet. Then very slowly feed the tool and bore the field. When the field is bored, remove it from the boring machine. By cutting the projections (P), Fig. 8, on the end-plates, and bending along the line (T) perpendicular to the plate, good strong base lugs for bolting the machine to a base may be made. Holes about ½ inch in diameter should be drilled in the lugs for this purpose.

If the outside surface of the field magnet is not smooth or neat enough to suit the builder, it may be benefited somewhat by grinding it smooth on an emery-wheel if one is at hand. The whole should then receive several coats of japalac, or bicycle paint. Do not paint the pole faces, as this is not necessary. This completes the field magnet for the 50-watt dynamo or motor. These instructions apply practically to all the machines.

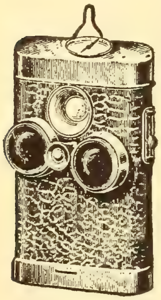
DATA FOR D. C. MACHINE, TWO-POLES, REFERRED TO FIG. 8

Machine	A dia.	B	C	D dia.	E rad.	F	G
	in.	in.	in.	in.	in.	in.	in.
A	3⅜	1½	¼	¼	3 3-16	3 11-16	1 1-4
B	3⅝	1¾	¼	¼	3 9-16	4 5-16	4-10
C	4⅜	1¾	⅜	⅜	4 1-16	4 7-8	1 4-5
D	5⅛	2⅜	½	½	5 1-16	6 5-16	2 1-3

(To be continued.)

A Boy Scout Signal Lamp

Few organizations have ever had as rapid and as healthy a growth as the "Boy Scout Movement" developed by the British hero of the Boer war, General Baden-Powell, out of ideas advanced by Ernest Thompson Seton and Dan Beard. Unlike the usual military movements, with which the title would class it, this organization aims at peace scouting, putting the emphasis partly on manly outdoor sports. Thus the requirements for advancing from a "tenderfoot" to a second-class and later to a first-class scout include the ability to send messages by signaling at the rate of at least 16 letters per minute.


SIGNAL LAMP

In this signaling, the boy scouts have been free to select thornughly modern equipment. Thus instead of using oil lamps for their signaling they have procured electric flash lamps which can be more easily carried in any position. One British concern has even brought out a special type called-the "Baden-Powell-Scout Lamp," consisting of two cells of battery with a miniature search-light mounted between them. A revolving arm carrying red and green lenses allows the color of the light to be changed instantly for signaling purposes, a compass in the top of the case helps the scout to keep his bearings correctly, and the whole outfit can either be carried on a belt or hung on a tree by a loop which folds out of the way when the outfit is slipped into a pocket.

The Magnetic Puzzle

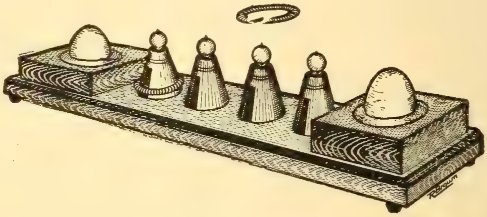
In the December issue there was a brief description in the Junior Section, of a magnetic puzzle. Therein it was stated that the north and south poles of the circular magnet were located in either side and next to the cut in the ring, the neutral point being on the opposite side of the ring. For the sake of accuracy it should be pointed out that this statement is in error. One pole is at the cut and the other pole on the opposite side of the ring, the two neutral points being half way between. This method of construction the manufacturer finds most economical.

Tell Others of Your Experiences

Readers of the Junior Section are invited to write letters concerning experiences they have had in the construction of electrical devices, interesting experiments they have made, electrical phenomena which they have noticed, etc., for publication in the department. It is probable that we will not find the space each month to publish all the letters, but will select those which contain the most of general interest. These letters should be carefully written on one side of the sheet and addressed to "The Junior Section, Popular Electricity Magazine." We can devote one or two pages a month to this interchange of experiences, which should work up into a valuable feature of the Junior Section.

Luminous Quoits

Patrons of the various shooting and ball-throwing booths that line the "Pikes" of summer parks and that nestle around circus tents know that the fascination is all the greater when a bell proclaims the accurate marksmanship. The same is true in many other games of skill, whether for children or for adults, many of which have had an added charm lent to them by the attaching of one or more bells. In the case of the old game of quoits a French firm of toymakers has gone still further by using electric lights instead of bells to announce the correct aim of the player. For this purpose each of the four pegs has a pair of metal contacts running down its sloping sides while the quoits themselves are braided out of a soft cord intertwined with bare brass wires so as to offer the lightness of a corded ring while much too soft to injure the globes over the incandescent lamps at each end of the base. A small dry cell under each lamp supplies the current which lights one of the lamps when the ring drops down on the contact.


LUMINOUS QUOITS

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine will be devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART X.—DETECTORS.

In discussing the construction of the receiving apparatus I am going to follow as far as possible the plan used in the preceding chapters, namely that of making each article complete in itself so that it will be of interest and value to the general reader.

Many experimenters have certain ideas of their own regarding the construction and operation of the receiving instruments. Each piece of apparatus under description therefore has been so designed that it may be used in connection with any receiving set. For the benefit of those who contemplate constructing the complete outfit without any departure from the plans given here I have described a case for mounting the instruments so that the set is compact and complete in itself.

Given a good pair of telephone receivers, the detector will largely determine the receiving range of a station.

During the past three years the crystal type detectors have come into extensive use principally because they are readily and easily adjusted. They can be used for portable work or on shipboard where jolts and jars would quickly throw an electrolytic detector out of adjustment. However, in spite of numerous new sensitive minerals and compounds, the electrolytic has held its own and stands at the top of the list in the order of sensitiveness. Its only drawback is that it requires more frequent adjustment than a mineral detector of the silicon type. For the amateur operator who is striving to do long distance work it is ideal.

There are two types of electrolytic detector, known as the "barepoint" due to Reginald A. Fessenden, and the "sealed point" of John S. Stone. The former is the most sensitive and the only one which will be discussed here.

Fig. 113 illustrates the principle and construction of an electrolytic barepoint detector. A thumbscrew carrying at its lower end an extremely fine piece of platinum wire is mounted over a small non-metallic cup which contains a 20 per cent solution of either chemically pure nitric or sulphuric acid, preferably the latter.

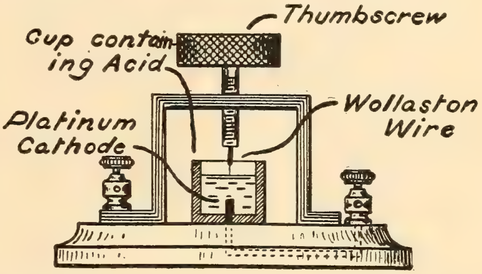


FIG. 113. SIMPLE ELECTROLYTIC DETECTOR

By turning the thumbscrew, the fine "Wollaston" platinum wire may be raised or lowered into the liquid. If the cup is made of some insulating material such as glass or hard rubber, a piece of platinum wire or foil is sealed in the bottom. The size is immaterial since its purpose is simply to establish an electrical connection with the liquid. This in turn is connected to a binding post mounted on the base. A second binding post connects with the standard supporting the thumbscrew and its fine Wollaston wire point. A battery and a pair of telephone receivers are then connected to the binding posts so that the current flows through the telephones to the fine platinum point, into the electrolyte through that and back to the battery, that is, the *positive* pole of the battery is connected to the *fine platinum wire.* Otherwise, the detector will be inoperative.

The thumbscrew is connected to the aerial and the electrolyte in the cup to an earthed plate. The illustration, Fig. 114, also shows an instrument called a potentiometer, but for the moment we will disregard its existence and purpose.

The sensitiveness of the detector, outside of its adjustment, will depend upon the size of the extremely fine platinum Wollaston wire and will be greater as the diameter of the latter is smaller. To the naked eye, Wollaston wire appears like an ordinary piece of platinum wire about .003 inch in diameter, but in reality it is a piece of silver having a platinum core from .0005 to .00002 of an inch in diameter. This extraordinary small diameter is obtained by plating a piece of fine platinum wire with silver until its diameter is increased several times. The whole wire is then drawn through a small die about .003 of an inch in diameter and the platinum core thus stretched out until it is microscopic.

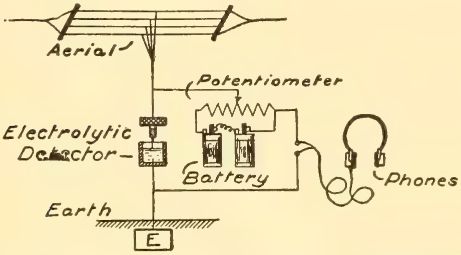


FIG. 114. CONNECTIONS FOR ELECTROLYTIC DETECTOR

The thumbscrew carrying the Wollaston wire at its lower end is lowered until the wire comes into contact with the electrolyte in the cup. The acid will dissolve the silver on the lower end of the wire and expose the fine platinum core. It is very important that too much wire should not be exposed or the point will be unable to pass below the surface of the liquid, as the surface tension will cause it to curl over and present a large, flat surface instead of a fine point.

The action of the detector depends upon the electrolysis of water. The acid is merely added to form an electrolyte and reduce the resistance of the water. As stated above the *positive* pole of the battery is connected to the *fine platinum point* and the negative to the electrolyte. When the current passes through the liquid it decomposes a portion of the water into its constituent gases.

$$\underset{\text{Water}}{H_2O} = \underset{\text{Hydrogen}}{H_2} + \underset{\text{Oxygen}}{O}$$

The gases appear as minute bubbles, the oxygen on the positive pole where the current enters the liquid and the hydrogen upon the large platinum electrode sealed in the bottom of the cup. The oxygen collects upon the fine platinum point and soon completely shields or insulates it from the liquid so that the current can no longer flow. The voltage of the battery of itself is insufficient to break down this film of gas. But when the detector is connected to the aerial and the earth it comes under the influence of the oscillatory currents set up in the aerial by the transmitter. These currents are alternating at an extremely high frequency. When the fine wire point of the detector is connected to the aerial and the positive half of the wave is passing, the added voltage is sufficient to break down the film of gas and permit the battery current to flow and register a sound in the telephone receivers. As soon as the wave ceases to pass, the film of gas is immediately reestablished.

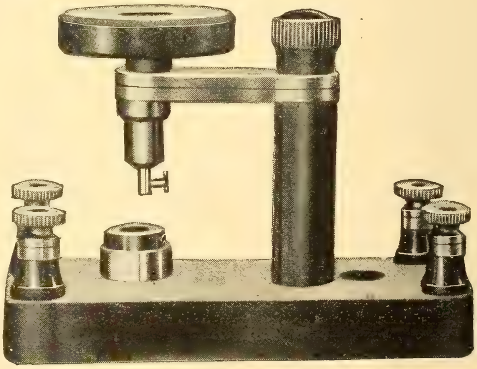


FIG. 115. ELECTROLYTIC DETECTOR

Fig. 115 is from a photograph of a novel electrolytic detector designed and used with excellent results by the author.

In order to place an electrolytic detector in the most sensitive condition, the fine platinum point should not revolve or have any other motion save a perpendicular one, when the adjusting screw is turned.

The base, Fig. 116, is an oblong piece of hard rubber 4½ by 2¼ by 9-16 inches, having the corners rounded and the faces polished so as to present a good appearance. Four holes which will just pass an 8-32 machine-screw are bored in the positions indicated in the illustration.

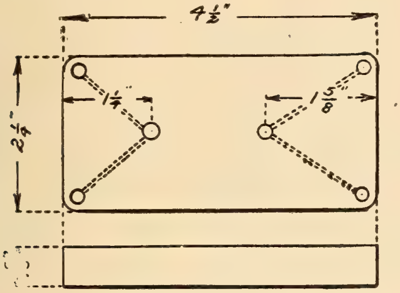


FIG. 116. HARD RUBBER BASE

The holes are countersunk in the under side of the base so that the heads of the screws will come below the surface. The dotted lines indicate the grooves through which the connecting wires pass.

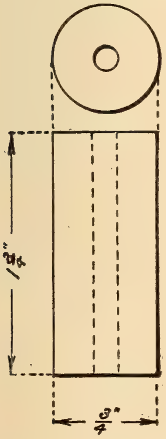


FIG. 117. HARD-RUBBER STANDARD

The hard-rubber standard, Fig. 117, is a piece of hard rubber rod 1¾ inches long and ¾ inch in diameter. The head of the adjusting-screw, Fig. 118, is a circular piece of hard rubber 1½ inches in diameter and ½ inch thick. Its exact shape and construction are most easily understood from the illustration. The purpose of the brass bushing shown in the sectional drawing, Fig. 119, is to avoid friction and wear, and make it possible to turn the adjusting-screw more easily. The bushing is formed of a piece of 5-16 brass rod ½ inch long having a hole bored through its longitudinal axis and threaded with a 10-32 tap. It should fit snugly into the hard-rubber head, where it is secured by a small brass pin.

A brass arm, Fig. 120, 2¼ inches long and ⅜ inch thick supports the moving parts of the detector. It is ⅝ inch wide at one end and tapers down to ½ inch at the other. The ends are rounded to coincide with the semicircumference of a circle having a diameter equal to the width at that point. A 3-16-inch hole is bored in the larger end and a ⅜-inch hole in the other to receive the upper end of the "barrel."

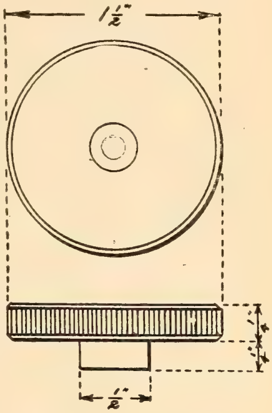


FIG. 118. ADJUSTING SCREW HEAD

This part of the detector, Fig. 121 is formed out of a piece of 7-16-inch round brass rod, 13-16 inch long. A hole 13-64 inch in diameter is bored through the axis of the barrel. This hole is enlarged for part of the distance to 9-32 of an inch. One end of the "barrel" is tapered as in the illustration in order to present a finished appearance. The other end is turned down to a diameter of ⅜ inch to fit the hole in the brass arm.

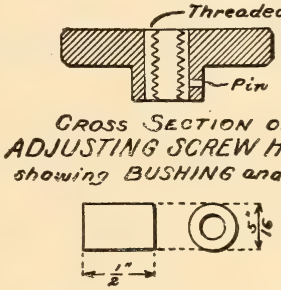


FIG. 119. DETAILS OF SCREW HEAD AND BUSHING

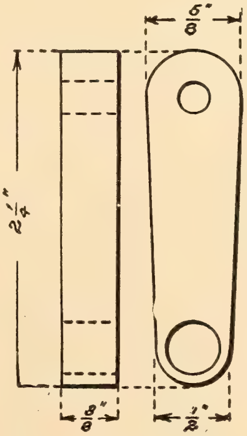


FIG. 120. BRASS ARM, SIDE VIEW AND PLAN

The shaft, Fig. 122, is a piece of brass rod 13-64 inch in diameter and 2¼ inches long. The lower end is bored with a 1-16 inch drill so that the Wollaston wire may be set in. A small knurled set-screw clamps the wire tightly in place. This part of the detector will be the most difficult to make

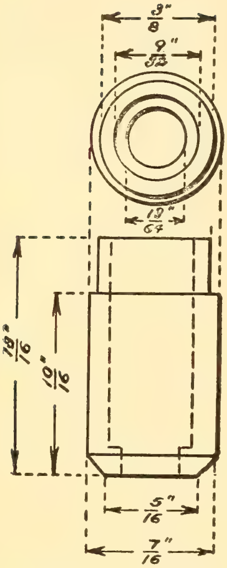


FIG. 121. BRASS ARM

since most experimenters do not possess a small screwplate set for threading the screw and tapping the hole. This operation should therefore be performed by a jeweler. Or instead, the pivot end of an old drawing compass or pair of dividers may be cut off and soldered onto the end of the shaft.

The upper end of the shaft is threaded with a 10-32 die for a distance of 1½ inches. A small piece of brass wire is bent into a ring which will just fit around the shaft and soldered at the base of the thread.

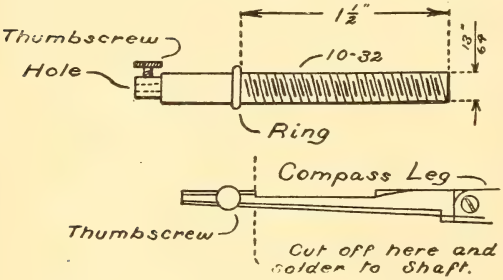


FIG. 122. SHAFT FOR HOLDING WIRE

(To be Continued.)

First Woman Ready to Send "C. Q. D."

In times of peril the "code of the sea" requires the captain to be the last to leave the ship, and just preceding him may go the wireless operator who must forget self and stick to his key calling for aid as long as possible.

The first woman to assume this responsibility is Miss Graynella Packer of Jacksonville, Florida, who recently took charge of the wireless equipment on board the steamship Mohawk of the Clyde line plying between New York and Jacksonville. Miss Packer is 22 years old, with two years experience as a telegraph operator.

Wireless Outwits the Censors

That all civilized nations will have to reckon with the wireless operators when endeavoring to censor news in time of war, was clearly proven during the recent disturbances in Portugal even though no long distance wireless station has yet been installed there. On the night following the third of October the steamer "Cap Blanco" stopped at Lisbon on its way from South America to Hamburg, being just in time to witness the beginning of the revolution. The operator promptly signalled the captain's observations to the sister ship of the same line, the "Ypiranga" which was then at Santander in northern Spain, separated from Lisbon by high mountains and a distance of about 420 miles.

Later the foreign correspondents of several newspapers boarded the "Cap Blanco," eager to forward messages which could not be sent by telegraph because of the strict censorship. Knowing that neither Spain nor Portugal has yet erected a public wireless station, the operator had to choose between the one at Algiers in northern Africa and that at St. Marie de la Mer, near Marseilles in France. Selecting the latter, he soon got into communication with it and forwarded the series of messages which gave authentic news of the situation at Lisbon to the outside world. The distance in this instance was about 800 miles, also with mountainous country intervening.

While the sending of these particular messages probably had no influence on the political or military situation, it is easy to surmise how such unauthorized communication with distant points might betray secret plans and seriously affect the game of war at critical times.

Wireless Thunderstorm Announcers

By suitably tuning the receiving apparatus, a wireless telegraph outfit can be made to respond to waves sent out by distant strokes of lightning. If the thunderstorm is approaching, these waves will increase in intensity and thus indicate the direction in which the storm is moving. A Spanish weather observer, de Garcia, is now trying to perfect an apparatus which will record these waves and their intensity, believing that such records may enable him to predict the coming of thunderstorms.

Fessenden Equipment of the U. S. S. Connecticut

By WILLIAM E. SMITH

FIG. I. U. S. S. CONNECTICUT

In 1909, the United States Navy Department issued proposals for bids on a high-power transmitting and long distance receiving set capable of communicating a distance of 1,000 miles during either day or night. It is a well known fact that wireless will reach a longer distance at night, possibly as much as three or four times the distance it will in daylight, due to the supposed effect of the sun's rays on electromagnetic waves. The National Electric Signal Company, builders of the Fessenden apparatus, secured this contract, and in August, 1909, installed a 25 kilowatt high frequency set on the U. S. S. Connecticut below the protected deck. The following is a general description of the apparatus:

The motor-generator set consists of a 25 kilowatt General Electric, 500-cycle, 110-volt, single phase alternator driven by, and directly connected to, a 35 horsepower, 120-volt, direct current motor at a speed of 2,000 revolutions per minute. Also directly connected on the alternator and motor shaft is a synchronous rotating spark gap consisting of an electrose disk three feet in diameter and one inch in thickness, on the edge of which is a copper band upon which are set at a uniform distance from each other, 30 copper electrodes, there being an electrode for each field coil in the alternator. These electrodes are four inches in length, and terminate in spade-shaped heads. The spark gap is completed by two stationary electrodes placed at equal distances on the opposite sides of the rotating disk. These electrodes are highly insulated by the use of electrose and porcelain bushings contained in a cast iron case, which also encloses the rotating disk. By means of a worm-gear these electrodes can be turned through a small arc so as to get the proper adjustment of these electrodes in relation to the revolving electrodes on the disk, when so adjusted, that an electrode comes opposite both of the stationary electrodes at the exact instant of maximum potential, obtained in the condenser, it produces a discharge across the gap for every alternation, thereby giving 1,000 discharges per second.

The distance between the stationary and rotating electrodes are from $\frac{1}{4}$ inch to $\frac{3}{8}$ inch on either side, making a total gap of from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch, but which in fact amounts to more than one inch on account of the spark

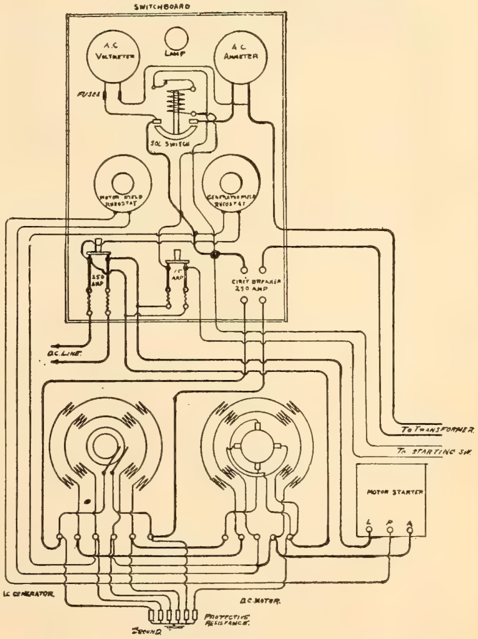


FIG. 2. SWITCHBOARD AND WIRING

jumping a little before and hanging on after the electrodes have passed.

Fig. 2 shows the switchboard and system of wiring for the primary circuits. The switchboard is of highly polished slate and consists of an alternating current voltmeter, 150 volt range; an alternating current ammeter, 300 ampere range, both instruments are of the Thomson inclined coil type; a solenoid switch for closing the alternating current circuit, controlled from the operating room; a motor field rheostat for varying the speed of the motor to bring the alternator up to the proper frequency; a generator field rheostat for varying the voltage of the alternator; one double pole single throw switch capable of carrying 250 amperes; a small fifteen-ampere, double pole, single throw switch on the relay key circuit, and two single pole, 250-ampere Westinghouse circuit breakers.

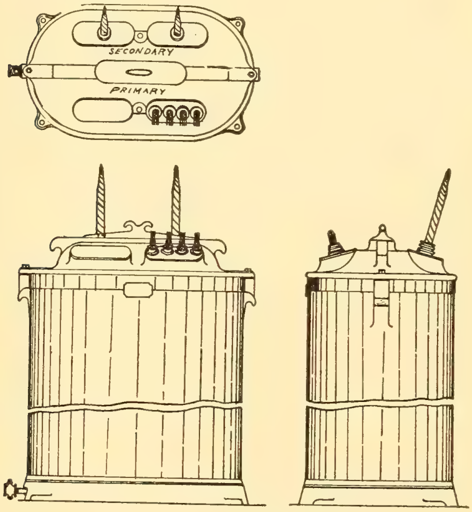


FIG. 3. TRANSFORMER

Fig. 3 shows the type of transformer used. The transformer is a 25 kilowatt and has oil insulation. The primary voltage is the same as that of the alternator—110 volts. From the secondary a voltage of 12,500 or 25,000 can be had. There are choke coils at each secondary terminal to prevent kick backs. It is also protected by an adjustable safety spark gap. The current through the primary is generally of constant value, but when necessary the current is regulated by varying the field strength of the alternator. The secondary is connected directly across the terminals of the rotary gap, across which is also connected the condenser in series with a variable inductance.

This condenser is of small size, having only a total capacity of .025 microfarad. It is made in two sections, each section being contained in a steel cylindrical tank about $1\frac{1}{2}$ feet in diameter and four feet in height mounted upon insulating legs. Fig. 4 shows this condenser in the interior and exterior.

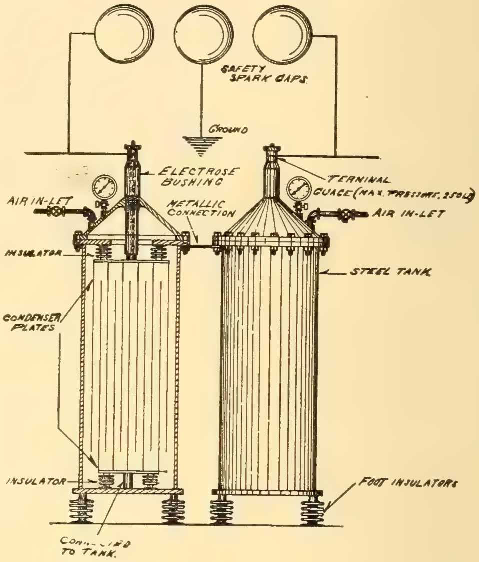


FIG. 4. SIDE VIEW AND CROSS SECTION OF CONDENSER

The condenser plates consist of steel plates 1-16 inch thick. The tanks are subjected to an air pressure of 250 pounds to the square inch, which forms the dielectric for the condenser plates. The series of plates in each tank are connected in multiple and the two groups are connected in series, the series connection being made by grounding a terminal of each condenser to the bottom of the tank, and the tanks being metallically connected together. The other terminal is taken through heavily insulated electrose bushings in the top of the tanks. From the two terminals leads are taken to three copper balls one foot in diameter, which are adjustable and form a safety valve for the condenser against excessive charging, the central ball being connected to ground.

The closed circuit inductance which is connected in series with the condenser consists of 40 turns of 1-16 by ½ inch phosphor bronze ribbon wound on its edge on an insulated cylindrical frame eighteen inches in diameter and suspended from an insulated axle. Suspended on the same axle is the aerial or open circuit inductance, movable to or from the closed circuit inductance, the coupling of the two circuits thereby being varied as to their mutual and self induction, the coupling in all cases being purely inductive. There is still another inductance made the same as the others and placed in series with the aerial and used as a loading coil by means of which, and the inductive coupling, the wave radiated is made extremely "loose," there being but one wave. The inductances can be revolved upon the axle, and by means of a wheel spring contact, turns or part of a turn can be had.

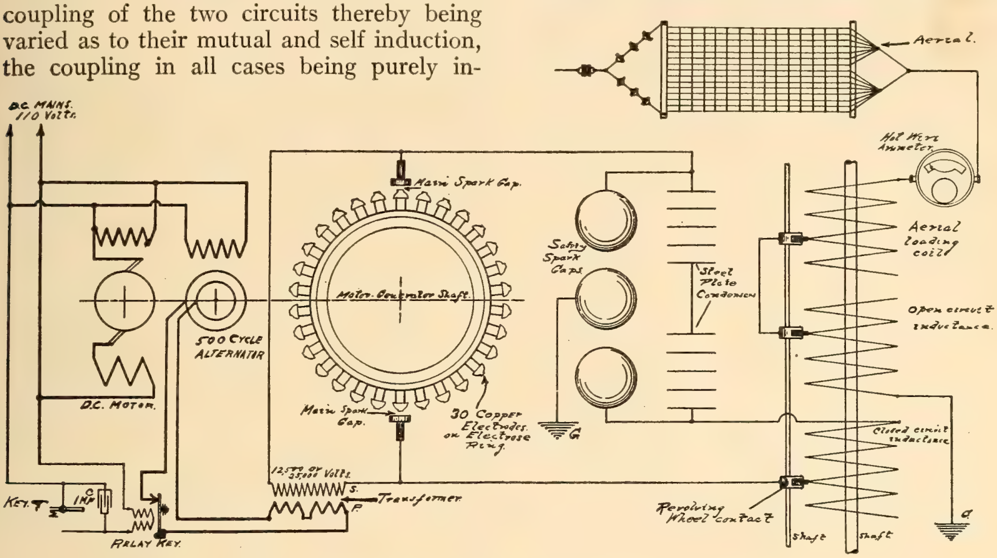


FIG. 5. DIAGRAM OF SECONDARY CONNECTIONS

All of the secondary connections are made with 2½-inch copper strip, so as to keep down the induction. Fig. 5 is a complete diagram of the connections. The transmitting key is of the relay series break type and is placed in the primary of the transformer. It consists of a standard Western Union key shunted by lamps or a condenser, placed in series with an electromagnet which operates the main key in the primary circuit.

The receiver used with this set is the Fessenden interference preventer. It is capable of tuning very sharply. It has, however, one objectionable feature, that is, the somewhat lengthy time it requires to get the proper adjustments. Fig. 6 shows the receiver connections. The aerial is led in singly to a variable inductance after passing through which it is divided into two branches. In each leg is a variable condenser and a variable inductance in series with the primary of an oscillation transformer, and then to a common ground. The detector circuit is inductively coupled by means of the secondaries of the oscillation transformers which are variable as to mutual and self induction. The detector is the well-known Fessenden electrolytic type, having the usual phones and potentiometer connected in multiple around it, a variable condenser is shunted around the detector which neutralizes the effect of static induction, and a sharper coupling is thereby obtained.

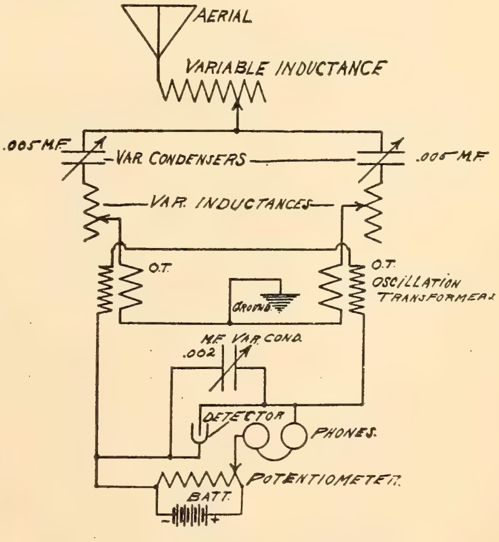


FIG. 6. RECEIVER CONNECTIONS

In conjunction with the above type of receiver is used the United States Navy Standard type I P 76 set, which the writer has found to be very simple and easily adjusted and capable of working over a great distance. The I P 76 is a complete receiving set of maximum efficiency, and contains every element necessary for the highest sensitivities and selectivity. It contains a transformer tuner with variable primary and secondary windings, and the secondary circuit is sharply tuned by means of a variable condenser, and an extra inductance coil is added to the primary circuit, enabling the operator to tune in very long wave lengths. The well-known perikon and pyron detectors are used, with a special potentiometer associated in order that the maximum sensitiveness of the detector can be obtained. This set also contains a special telephone condenser, special test buzzer and protective spark gap. The receiver connections are shown in Fig. 7. The aerial is led in singly to the variable inductance, after which it passes through the primary of an oscillation transformer and then to ground. The detector circuit is inductively coupled by means of the secondary of the oscillation transformer which is variable as to self and mutual induction, and is shunted by a variable condenser, the detector having a pair of adjustable phones and potentiometer connected in multiple around it. A variable condenser is also shunted around the detector.

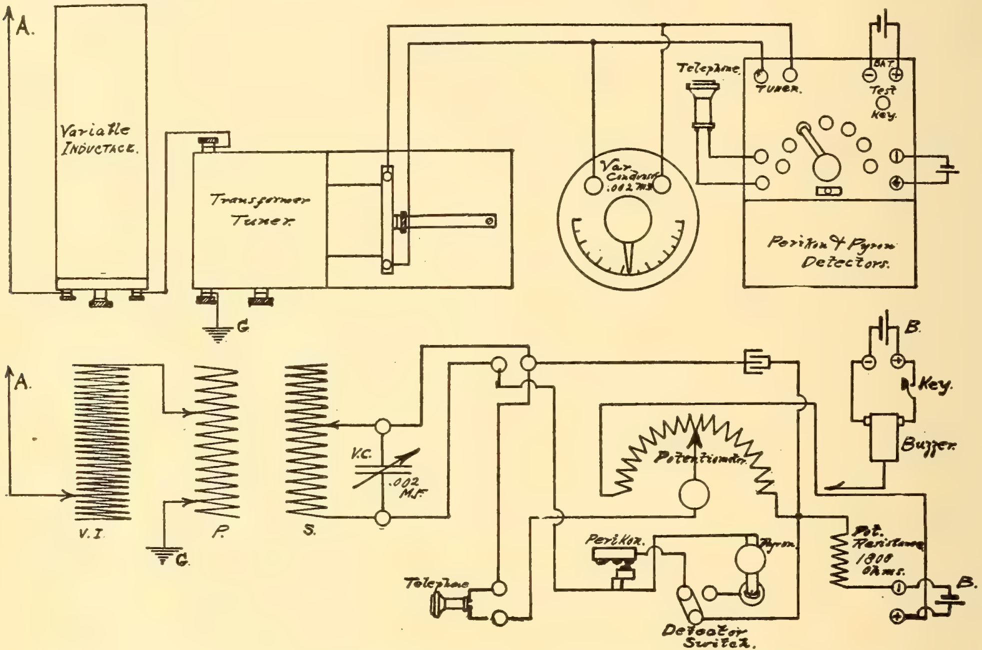


FIG. 7. DIAGRAM OF UNITED STATES NAVY STANDARD I. P. 76 RECEIVING SET

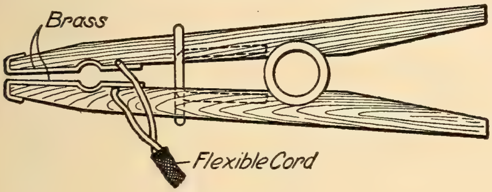
The aerial on the U. S. S. Connecticut is a radical departure in aerial construction. It is made of No. 7–22 phosphor-bronze aerial wire, and consists of fifteen wires running lengthwise and at equal distance cross-connected by fourteen other wires. The lengthwise wires are spaced 2¾ feet apart, and are suspended on spreaders 40 feet long by 2½ inches in diameter, and are of such construction that the aerial can be easily changed from straight away to loop type. This type of construction gives the aerial a large capacity and its natural period large, the wave length used being about 1,200 meters. The aerial is insulated by means of eighteen-inch electrose insulators connected in series so as to form a creeping surface of 54 inches, which is connected to the ends of the spreaders and guyed back to the masts and made fast. When the Connecticut was in the southern drill grounds off Cuba, this station was heard and copied in Chicago, San Francisco and Brant Rock, Mass. The writer has just received word that the world's record for long distance wireless communication, "not signals" has been broken by the U. S. S. Tennessee, a distance of 4,580 knots.

Sacramento (Cal.) Wireless Club

The following officers were elected by the Sacramento Wireless Club: Elwood Rackliffe, president; William Archibald, vice-president; Louis Huber, secretary; Elwood Miller, chief operator; John Murry, assistant operator; Fred Strader, sentinel. The object of the Club is to study wireless telegraphy and to aid in promoting non-interference between Government, commercial and amateur stations.

Convenient Helix Clip

A very satisfactory helix clip may be made of a spring clothes pin after the manner shown in the illustration. Fit the inside of the clips with brass straps. These will stay in place but may be held more secure by making a small dent through the brass into the wood with a nail-set. The flexible cord is soldered under both clips. Rubber tape may be wound about the handles if additional insulation is desired.



HELIX CLIP

—Fred S. Walker.

Wireless Problems

Wireless telegraphy of tomorrow will no doubt have solved the two problems which today make this means of communication not as positive as it should be.

The first problem, the means of preventing interference whether malicious or otherwise will no doubt yield to some method of close tuning which will make two stations responsive to each other's waves over a very small variation in wave length.

The other problem received emphasis in the flight of the Wellman balloon when efforts were made to signal the steamer Trent. No way has yet been devised for calling an operator to his instrument when another station desires to communicate with him. Notwithstanding the clicking of frantic appeals by the operator on the dirigible when within easy range, the operator on the Trent was all unconscious of this until his own needs directed him to his outfit.

Strangely enough the coherer first used by Marconi gave a signal when actuated by ether waves, but with the entrance of more delicate and long range instruments this valuable asset was lost.

WIRELESS QUERIES

Answered by B. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

Energy for Two-Inch Coil

Question.—How many volts and amperes will I need to operate a two-inch spark coil satisfactorily?—A. W. F., Chester, Pa.

Answer.—About twelve volts and four amperes.

Voltage for One-Inch Spark Coil

Question.—Is 27 volts too much to apply to a one-inch spark coil?—L. E. F., Madison, Maine.

Answer.—From four to six volts is enough.

Construction and Operation of a Ten Inch Coil

Questions.—(A) What voltage and amperage are required by the 10-inch coil whose dimensions are given on page 163 of the June, 1910, issue? (B) Can the above coil be run on 110 volts direct current in series with an electrolytic interrupter? What would be the amperage? (C) Should the secondary sections be boiled in paraffin or painted with shellac when enameled wire is used? (D) Would it better the insulation if the coil were permanently placed in linseed oil? (E) What is the kilowatt rating when the coil is on 110 volts? (F) What is the secondary voltage when used as in question (B)?—R. N., New York, N. Y.

Answers.—(A) About seven amperes and 24 volts.

(B) Yes, but if to be used this way great care should be taken in winding to secure the best of insulation between sections of the secondary. Most low-priced electrolytic interrupters require at least 20 amperes to make them operate properly.

(C) The former method will be better.

(D) Yes, far better,

(E) According to answer of (B), about two kilowatts.

(F) On no load, and with the spark terminals set at ten inches, about 150,000.

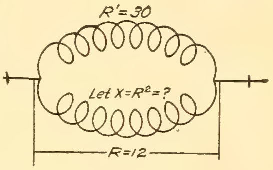
QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

Resistance in Divided Circuits

Question.—If the combined resistance of two coils of wire in parallel is known and also the resistance of one of the coils, how can the resistance of the other coil be found?—N. G. B., Marlboro, Mass.

Answer.—The term conductivity is sometimes used to express the inverse of the resistance of one or several circuits in parallel. Thus, if R is the resistance of a divided circuit, 1-R represents the conductivity. We may use this to form an equation:



$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}$$

where

R = resistance of two circuits in parallel.
R_1 = resistance of one of the circuits.
R_2 = resistance of the other circuit.

$$R=\frac{R_2 \times R_1}{R_1+R_2}$$

Substituting from the diagram using X for the unknown resistance and solving

$$12=\frac{X \times 20}{20+X}$$

$$20X = 240 + 12X$$

$$8X = 240$$

$$X = R_2 = 30 \text{ ohms.}$$

Stranded Wire for High Frequency Currents

Question.—Why is a stranded wire better to use with high frequency currents than a solid wire?—C. V. V. T., Helena, Ark.

Answer.—High frequency currents permeate copper wire according to theory only about one three hundredth of an inch, so in order to increase the surface and decrease the resistance stranded wire is used.

What is Electricity? Radiometer

Questions.—(A) How may we define electricity? (B) What is a radiometer?—G. R. D., Kingston, Ont.

Answers.—(A) Our definition of electricity is limited to telling what it is in terms of energy into which it can be transformed, and in stating what that energy does. Electricity, magnetism, light, heat and motion are names of related energies. A study of one leads into the realm of the other. Through allied energies we shall probably some day find out just what electricity is.

(B) Crookes discovered that light or heat brought near a radiometer produce motion in its disks. A radiometer consists of a bulb of glass within which upon an axis are supported four mica disks on aluminum wire arms. One side of each disk is coated with lamp black and the other left with a clean surface. Ordinarily the bulb is partially exhausted of air. When light or heat rays fall upon the disk the lampblack absorbs them and becomes hotter than the other side. The molecules of confined gas striking the hotter side rebound and if the black surface is movable drive it backward. Moonlight produces no effect. An ordinary candle rotates a sensitive radiometer slowly and bright sunlight rapidly.

Rectifier Solution

Question.—What is the solution used in the cell of a rectifier consisting of an aluminum plate and a conducting plate such as carbon, lead or iron?—J. W. B., Clemson College, S. C.

Answer.—Acidulated sodium phosphate.

Bichromate Solution

Question.—Kindly give solution for bichromate battery.—H. G., Orange, N. J.

Answer.—The electrolyte is a solution of potassium bichromate, one part; sulphuric acid, three parts; water, nine parts.

Compensation for Patent Infringement
Profits Recoverable

By OBED C. BILLMAN, LL. B., M. P. L.

Profits—Recoverable in Equity.—The rule in equity is that the amount recoverable for an infringement is the amount of profits realized by the infringer by reason of his unlawful use of the patent. A suit in equity cannot be maintained solely to recover profits because more favorable than the rule of damages at law, but the jurisdiction must first be founded upon some independent equity, such as the right to an injunction, whereupon profits will be awarded as an incident of complete relief.

Principle on Which Awarded.—It is said that the infringer is converted into a trustee as regards the profits made, or rather that a court of equity will award as a substitute for legal damages a compensation measured by the rule that courts of equity apply in the case of a trustee who has wrongfully used trust property to his own advantage.

Estimation of Profits—*In General.*—The adjustment of the profits recoverable is subject to all the equitable considerations which are necessary to do complete justice between the parties.

Actual Profits or Advantage Gained.—Profits are the gains upon any business when both receipts and payments are taken into account, and in suits for infringement are confined to the worth of the actual advantage gained by the infringer by using the infringed invention over other available modes for accomplishing the same end. They are the saving or benefit arising directly from the use of the patented invention, and are recoverable although the particular business resulted in a loss, where the loss was less than it would have been except for the infringement. It is the profit actually made or which ought to have been made, and not the profit which might have been made, that is recoverable. The question of reasonable diligence does not enter into the calculation. Remote, contingent, or speculative profits are not recoverable. The burden of proof is upon the plaintiff to show the worth of the advantage gained, and in the absence of satisfactory proof only nominal damages will be allowed. The ordinary rules of evidence are applicable to this subject.

Where Complainant's Device is Used with Other Devices or is Merely Improvement.—If any portion of the profits arose from an improvement made by the defendant, or if the patent covers only some features of the device, and not the entire device, or if the patent is merely for an improvement on an old machine, the profits realized by the defendant must be apportioned, and the complainant is entitled to recover only so much thereof as arose from the use of his invention, and not the entire profit. The burden of proof is upon the plaintiff to show how much of the profit was due to the use of his device, and in the absence of such proof only nominal damages may be recovered; though the view has been taken that the defendant must show affirmatively the amount of credit to which he is entitled.

Exception.—Where the invention, though an improvement, adapts the machine or article to a particular use, and there is no way open to the public to supply that use, the patentee is entitled to the entire profits. So where the defendant's device derives its entire commercial value from the use of the plaintiff's invention, or where the infringing device is an independent marketable article though designed and actually used in connection with other devices, the entire profit made by the defendant may be recovered.

Profits From Construction of Patented Device.—Where the profit is derived from the construction of the thing patented, the infringer must account for the whole profit arising from the construction.

License Fees as Measure of Profits.—License fees, in the absence of other evidence, may be taken as the measure of profits, but an established license fee does not deprive the patentee of the right to recover profits.

Time to be Included in Accounting.—The account should extend over the time of the infringement only, and down to the time of the hearing before the master, if the infringement has continued so long. But by a recent statute the profits recoverable are limited to those arising from acts of infringement committed within six years before the bringing of suit.

Deductions Allowed to Infringer.—In estimating the profits for which an infringer is liable, it is proper to make an allowance for the cost of conducting the business. Various items have been allowed or disallowed under this head in particular cases.

Apportionment of Expenses.—If the defendant is engaged in other business besides that involving the patented invention, the general expenses must be fairly apportioned.

Interest on Profits.—Profits are to be regarded in the light of unliquidated damages, which usually do not draw interest without order of the court before the final decree, or at least not before the filing of the master's report.

DAMAGES IN SUIT IN EQUITY UNDER STATUTE.—Under Rev. Stat. U. S., No. 4921, damages of a compensatory character may also be allowed to a complainant suing in equity where the gains and profits are clearly not enough to compensate him for the injury sustained by the infringement, and the court has the same power to increase such damages in its discretion as it has in actions at law.

NEW BOOKS

WIRELESS TELEPHONES. By James Esrkine-Murray, D. Sc. New York: The Norman Henley Publishing Co (London: Crosby Lockwood and Son). 1910. 68 pages with 17 illustrations. Price $1.00.

Telling how sound is converted into electric waves and describing how high frequency waves are radiated and how absorbed by wireless telephone detectors.

MODEL BALLOONS AND FLYING MACHINES. By J. H. Alexander. New York: The Norman Henley Publishing Company (London: Crosby Lockwood and Son). 1910. 127 pages with 45 illustrations. Price $1.50.

Teaching the theory and construction of balloons and lighter-than-air machines and showing by models the principles of their operation.

THE TESLA HIGH FREQUENCY COIL. By George F. Haller and Elmer Tiling Cunningham. New York: D. Van Nostrand Co. 1910. 179 pages with 56 illustrations. Price $1.50

Describing the construction of a twelve-inch Tesla coil, with its transformer and all other accessories and introducing interesting information concerning the uses of the coil.

CONSTRUCTION OF INDUCTION COILS AND TRANSFORMERS. By H. Winfield Secor. New York: Modern Electrics Publication. 1910. 92 pages with 56 illustrations. Price, paper, 25 cents.

A book designed to place in ready form the latest data and tables desired by the average experimenter and builder of induction coils and transformers. A section is devoted to the Tesla coil. and instructions are given for building a large coil of this type for use on stage and lecture platforms. The construction of open and closed core transformers up to three kilowatts is given in detail.

An appendix contains practical tables covering coil and transformer dimensions, spark distances and wire values.

HOW TO READ TELEPHONE CIRCUIT DIAGRAMS. By David S. Hulfish. Chicago: Electricity Magazine Corporation. 1910. 257 pages with 570 illustrations and diagrams. Price, $1.50.

The title of this book states its intention. The numerous simple diagrams it contains with their explanations should render easy the more complex ones of switchboards and other apparatus and enable one to "read the blue prints" without trouble.

Electrical Trades Directory

The Electrical Trades Directory and Hand Book is published soon after the end of January each year by the Electrician Printing and Publishing Company (Limited), Salisbury Court, Fleet St., London, England. It contains the names and addresses of electrical manufacturing concerns and allied industries in England and her colonies, Europe, United States, South American republics, Africa, Japan and the Far East. The "Big Blue Book," as it is called, is as near complete as a work of such scope can well be. The subscription price for the 1911 edition, if ordered before January 31, is $2.04 plus postage, which is 84 cents to the United States. Copies ordered after that date will be $3.60.

ON POLYPHASE SUBJECTS

"Live Batteries"

That strange and almost uncanny inhabitant of tropical waters, the electric eel, together with his equally mysterious brethren, the torpedo fish and the electric ray are frequently the subject of conversation. Many are the stories brought back by travelers of the wonderful powers of these animals, though most people are inclined to think the stories rather "fishy." That the reports which we hear are not exaggerated is, however, borne out by the investigations of men of reputed scientific accuracy, and the mysterious reptiles or fish do carry an electrical generating apparatus and means of discharging the current, of sufficient power to stun a horse or man. Some real facts concerning the physical nature of these pests of the Amazon and of the Mediterranean and the extent of their powers are contained in the article, "Live Batteries," which appears in another part of this issue. The author of this interesting discussion, Mr. Warren H. Miller, is well fitted to handle the subject, inasmuch as he is not only well trained in matters pertaining to electricity but must also have ability as a naturalist, or he would not be holding down the editor's chair on "*Field and Stream*," which position he has recently accepted.

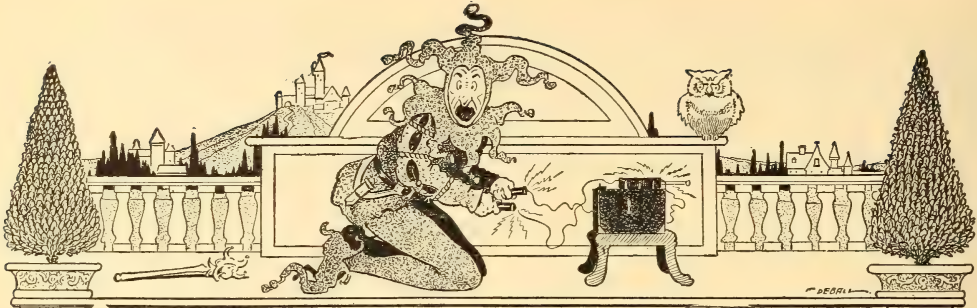
Snow-melting Trolley Cars

Every street railway outside of the tropics has its snowplows, but these only sweep or shove the snow off the space between the rails, leaving it heaped up along both sides of the street until carted off. This carting is expensive for the city, while merchants and manufacturers suffer from the delay in team traffic while waiting for the snow to be shoveled into wagons and hauled away. Nature's own way of removing the snow consists in melting it when the weather gets mild enough. A London engineer, A. V. Emerson, has invented a snow-melting trolley car for use when the cold weather continues, instead of waiting for this change in temperature. According to his plan, a trolley car is equipped with rotary brushes which sweep the snow into the back of the car where stones and rubbish are separated from it by screens, after which the snow is passed over hot plates so as to melt it. The plates could be heated by coal or, if plenty of current is available, by electricity from the trolley circuit. In practice this would mean the curious sight of a car plowing its way into deep banks of snow, with the latter disappearing almost miraculously as the car moves along.

We Wonder Why

"Why can a small copper wire carry so much energy?" is a question that often arises when we see an electric motor running dozens of machines in a factory or shop, with only two or three little wires as the roadway for the current to the motor. Many scientists have attempted to give a reason or plausible theory for this, and all have to agree with Mr. Edison, who says we are only gropers today as compared to what will be known about this wonderful form of energy in the future.

Reasons like the following, have been advanced. The power of a moving object depends not only upon its mass or weight but also upon its velocity. Small bodies thrown with a high velocity have energy equal to that of a much heavier body going at a slow gait. This is why radium possesses such enormous energy. The particles which it shoots out are very small but travel with the quickness of light. Rankin once said that a spider web running over pulleys with the velocity of light would be capable of running all the machinery in England. In placer mining, a small stream of water at high velocity tears away great quantities of rock. With all these things in mind it is not so far to go in order to partially explain, at least, how thousands of horsepower of electrical energy, moving with lightning velocity under some form which we have not yet fathomed, travel over an insignificant wire.



SHORT CIRCUITS

Little Davy was forever asking questions. "You'd better keep still or something will happen to you," his tired mother finally told him one night,"curiosity once killed a cat, you know."

Davy was so impressed with this that he kept silent for three minutes. "Then: Say mother, what was it the cat wanted to know?"

* * *

"Does this car go to 24th Street?"

"No ma'am; but I have something just as good," replied the conductor, who was formerly a drug store clerk, "I can let you off twice at 12th Street."

* * *

A colored man complained to the storekeeper that a ham which he had purchased there was not good.

"The ham is all right, Zeph," insisted the storekeeper.

"No, it isn't, boss, indeed," insisted the negro. "Dat ham's shore bad!"

"How can that be," continued the storekeeper, "when it was cured only last week?"

The colored man scratched his head reflectively, and finally suggested:

"Well, sah, then it must have had a relapse."

* * *

"Every time I sees a Boss what's got a sign tacked to his desk about "DO IT NOW." "DON'T WATCH DE CLOCK," or some such gimcracks, I puts him down fer a pin-hed sise. I had one oncet. He never went fishin' ner saw no bawl game nor knowed the diffnishun of the word "fun". He handed me back flips of advice in castor oil doses. He'd tell me ter work hard'n urn my pay'n the raise'd come later. So will Annie Domminy 1954. He'd watch de payroll's close 's a cat watchus a mice hole 'n den tell me not ter watch de clock. If dat Boss is on to his job a watchin' de clock when I comes in in de mornin', I'se gotter rite to take my turn about quittin' time. Sass for de guse is sass fer de gander. If my pay cud be jacked up sumwat, the ginger I waste tryin' to make my two ends meat could be used workin' for de Boss. Consider de vegitables 'n beaf stake, how dey grow in price. Dey toil not neider do dey spin, but de "cush" to buy grub wid duz a "walse-me-around again Willie" tell yer feels most frantic. I tackled dat Boss fer a boost in my envelope. I got it but not in de envelope.—*Trumbull Cheer.*

* * *

Bishop Charles W. Smith, at a harvest dinner in Portland, said of the harvest spirit: "The harvest spirit is one of thankfulness, but there are some crabbed old farmers who couldn't be thankful if they tried. I said to such an old fellow as he conducted me over his farm on a golden autumn afternoon and showed me a record harvest: 'Well, sir, this year, at least, you've got nothing to complain of.' 'I don't know, about that Bishop,' he answered, with a shake of the head 'I'm afraid there'll be no spoilt hay for the young calves.' "

* * *

"Paw, what's a pretzel?"

"A cracker with the cramps, my son. Now go to bed."

The schoolmaster was calling on an indignant mother.

"For my part." gabbled the good woman, "I can't deceive what on earth eddification is comin' to! When I was young, if a gal only understood the elimens of distraction, provision, replenishing, an' the common dominator, an' knew all about the rivers an' their obituaries, the currents, an' the dormitories, the provinces an' umpires, they had eddification enough!"

* * *

One day a big city bank received the following message from one of its country correspondents: "Pay twenty-five dollars to John Smith who will call today." The cashier's curiosity became suspicious when a cabman assisted into the bank a drunken "fare" who shouted that he was John Smith and wanted some money. Two clerks pushed, pulled and piloted the boisterous individual into a private room away from the sight and hearing of regular depositors. The cashiers wired the country bank:

"Man claiming to be John Smith is here. Highly intoxicated. Shall we await identification?"

The answer read: "Identification complete. Pay the money."

* * *

A little boy was entertaining the minister the other day until his mother could complete her toilet. The minister, to make congenial conversation, inquired:

"Have you a dog?"

"Yes, sir; a dachshund," responded the lad.

"Where is he?" questioned the dominie, knowing the way to a boy's heart.

"Father sends him away for the winter. He says it takes him so long to go in and out the door, he cools the whole house off."

* * *

Mother: "But what did you do with the penny I gave you yesterday?"

Tommy: "I spent it, mother. A feller has to hold up his end with the rest of the boys."

* * *

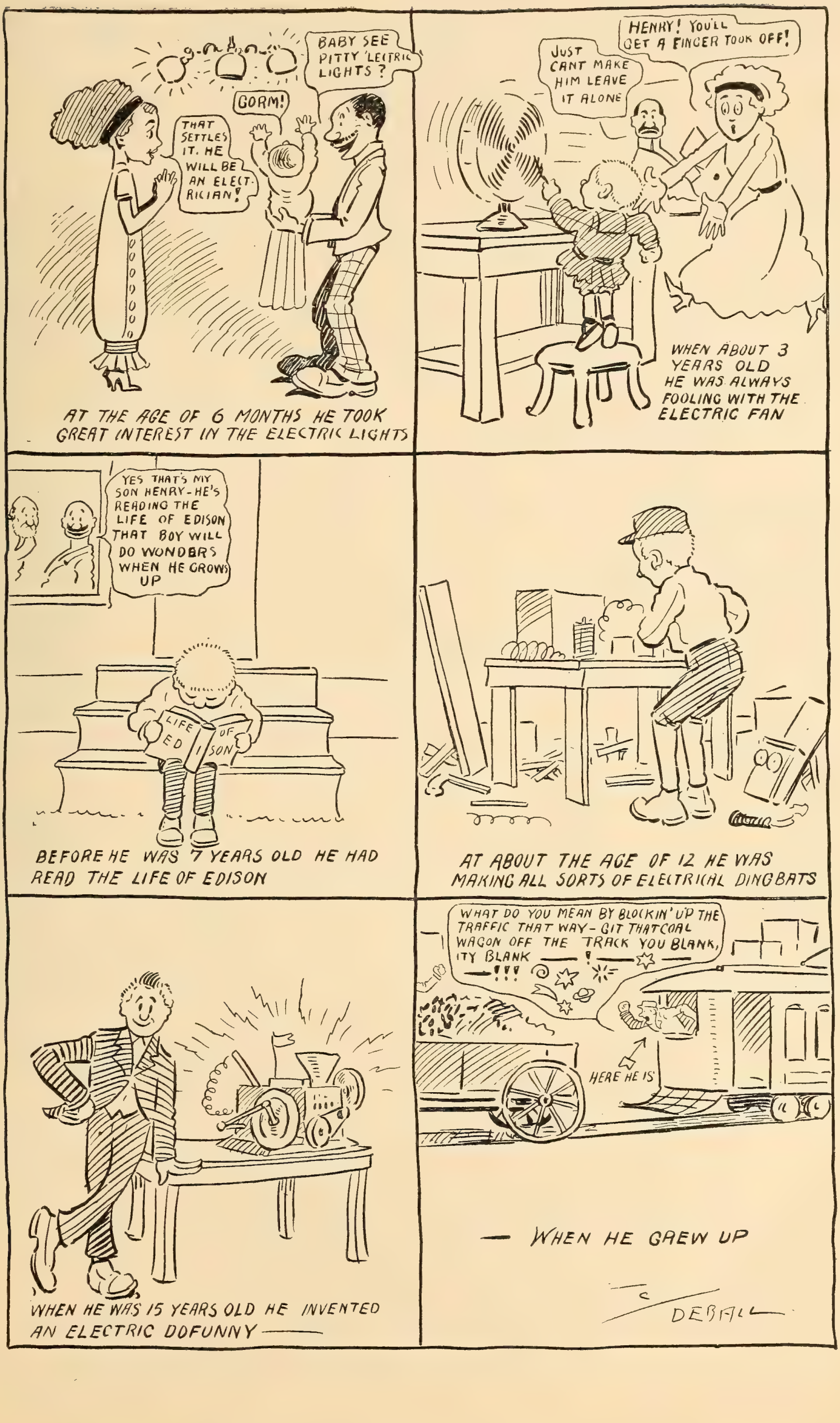
When charged with being drunk and disorderly and asked what he had to say for himself the prisoner gazed pensively at the magistrate, smoothed down a remnant of gray hair, and said:

"Your honor, man's inhumanity to man makes countless thousands mourn. I'm not as debased as Swift, as profligate as Byron, as dissipated as Poe, as debauched as—"

"That will do!" thundered the magistrate. "Ten days! And, officer, take a list of those names and run 'em in. They're as bad a lot as he is!"

* * *

The story is told of a professing church member who, while regular in his attendance, was a scant contributor. When a new fence was needed around the graveyard, he was approached by the vestry for a donation. "I don't think a fence is necessary," said he. "Them as is in there can't get out, and them as is outside don't want to get in, so I guess I'll not subscribe."


BABY SEE PITTY 'LECTRIC LIGHTS?
GORM!
THAT SETTLES IT. HE WILL BE AN ELECTRICIAN!
AT THE AGE OF 6 MONTHS HE TOOK GREAT INTEREST IN THE ELECTRIC LIGHTS
HENRY! YOU'LL GET A FINGER TOOK OFF!
JUST CANT MAKE HIM LEAVE IT ALONE
WHEN ABOUT 3 YEARS OLD HE WAS ALWAYS FOOLING WITH THE ELECTRIC FAN
YES THAT'S MY SON HENRY - HE'S READING THE LIFE OF EDISON THAT BOY WILL DO WONDERS WHEN HE GROWS UP
LIFE OF EDISON
BEFORE HE WAS 7 YEARS OLD HE HAD READ THE LIFE OF EDISON
AT ABOUT THE AGE OF 12 HE WAS MAKING ALL SORTS OF ELECTRICAL DINGBATS
WHEN HE WAS 15 YEARS OLD HE INVENTED AN ELECTRIC DOFUNNY ——
WHAT DO YOU MEAN BY BLOCKIN' UP THE TRAFFIC THAT WAY - GIT THAT COAL WAGON OFF THE TRACK YOU BLANK, ITY BLANK —— ! —— —— !!!
HERE HE IS
— WHEN HE GREW UP
DEBALL

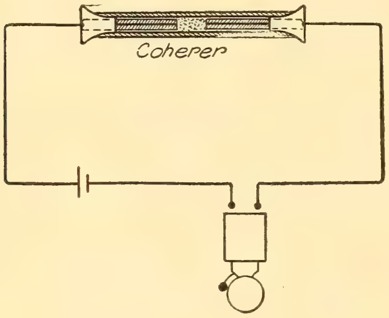
COMMON ELECTRICAL TERMS DEFINED

In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.

Code, Continental.—The telegraph code used in Europe and other countries outside of the United States and Canada. Sometimes called also the European or Universal code. Quite generally used by wireless companies except in America.

Code, Morse.—A system of dots, dashes and spaces devised by Morse to signify letters in the transmission of messages by telegraph. Used exclusively on land in the United States and Canada.

Coherer.—A device used by Marconi in his experiments in 1894, consisting of a glass containing metal filings between the ends of brass rods just fitting the tube. The filings and rods are connected in series with a battery and bell. Wireless waves will cause the filings to "cohere" thus reducing the resistance of the circuit and operating the bell, the hammer of which taps the tube and places the filings in a disturbed state again. (See cut.)



Collecting Brush.—See Brush.

Collecting Ring.—A ring of insulated conducting metal placed on the shaft of any revolving portion of machinery to which current is conveyed by a brush contact on the circumference of the ring, a second ring and brush being used as a return circuit. Such rings are provided on alternating current generators.

Collector.—A term applied to the brushes on the commutator of a generator, or on the collecting rings of an alternator. Also applied to the points of the comb facing the revolving glass plate or cylinder of an influence machine and collecting the static charge.

Comb. A bar having projecting teeth like a comb. Used to gather up the electricity on an influence machine.

Combination Fixture.—A lighting fixture so arranged as to furnish either gas or electric light.

Commercial Efficiency.—The useful energy which a machine produces divided by the total energy put into it. In a dynamo for example, it is the total horsepower sent out over the external circuit divided by the horsepower applied. Some of the latter is used up in friction of bearings, eddy currents, windage, etc.

Commutator.—That part of a direct current dynamo or motor upon which brushes rest and collect or distribute current. The commutator is so designed as to cause the alternating currents produced in the armature to flow from the brushes as direct current.

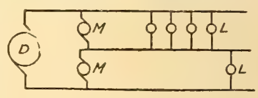
Commutator Bars.—The copper bars running lengthwise on the commutator of a dynamo or motor. These bars are connected to the armature coils and insulated from each other.

Commutator Segments.—See Commutator Bars.

Compass.—A magnetized steel bar or needle, pivoted so as to respond to the directive action of the earth's magnetism.

Compensating Coil.—An adjustable resistance connected in shunt with the series winding of a compound wound machine so that the effect of this winding may be varied.

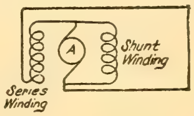
Compensator.—(1) Applied to two machines. (See cut.) (M) and (N) coupled together on a three-wire system each generating one-half as much pressure as the dynamo (D). The one on the more lightly loaded side runs as a motor driving the other as a dynamo. When the system is perfectly balanced both machines run as motors without load. These machines are also called equalizers. (2) An arrangement whereby a voltmeter at the dynamo will read correctly the voltage at the outer end of the feeder without running special pressure wires to the point where the reading is desired. Such a voltmeter is called a compensated voltmeter. (3) A device for starting induction motors by cutting down the voltage with an auto-transformer until the motor comes up to speed on the reduced voltage, when by throwing a switch the full line voltage is applied to the motor.



Compensating Magnet.—A magnet placed near the compass on an iron or steel ship to counteract the effect of the metal of the ship on the compass needle.

Compensating Poles.—Small bar electro-magnets placed between the poles of a dynamo or motor to compensate for cross magnetization in the armature due to the lead of the brushes. (See Brushes, Lead and Lag.)

Compound Dynamo.—A dynamo having two windings on the field poles. One winding is in series with the armature and external circuit while the other winding is connected across the brushes of the machine or in shunt or parallel with the armature. (See cut.)



Compound Magnet.—A magnet built up of a number of magnets. Small magnets may be more strongly magnetized than large ones, so that a compound magnet may be made more powerful with the same amount of energy than a large one.

Will You Try Johnson's Wood Finishes at our Expense

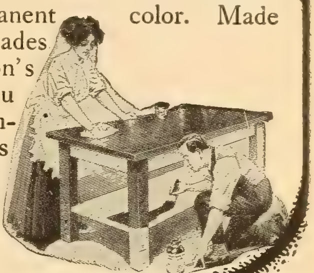
You can get samples of Johnson's Wood Finishes together with copy of their 25c Booklet, "The Proper Treatment for Floors, Woodwork and Furniture," absolutely Free. This booklet tells how to finish or refinish your woodwork, floors, and furniture—in fact, how to finish and refinish all wood.

Read Free Offer below.

Johnson's Prepared Wax

used for polishing all kinds of furniture (including pianos), woodwork and floors. Used also for finish over dyed wood surfaces producing that beautiful artistic dull finish so much in vogue at the present time.

Johnson's Wood Dye



—not a varnish stain—but a deep-seated Dye that penetrates the wood and fixes a deep, rich, permanent color. Made in 14 attractive shades

With Johnson's Wood Dye you can make inexpensive soft woods as beautiful and artistic as the most expensive hard woods.

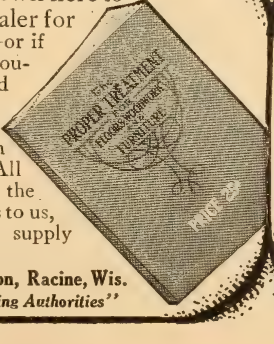
Johnson's Kleen Floor

For cleaning all polished floors, stairs, and varnished surfaces, keeping them in perfect condition. Applied with a cloth and rubbed dry. removes all spots and discolorations in and above the varnish. After using, give the surface a coat of Johnson's Prepared Wax and your floors and stairs will look better.

Johnson's Under-Lac

a thin, elastic spirit finish far superior to varnish or shellac. Not thick or sticky or slow-drying like varnish—neither does it dry too quickly like shellac. Especially good on linoleums and oilcloth, bringing out the pattern and giving a finish as glossy as new. Protects from wear—makes cleaning easy. Dries hard in an hour. Gallons $2.50—quarts 70c—pints 40c.

Free Booklet and Sample Offer


THE PROPER TREATMENT FOR FLOORS, WOODWORK AND FURNITURE
PRICE 25¢

Present coupon shown here to your leading paint dealer for samples and free book—or if more convenient mail coupon to us and we will send you, free and postpaid, book and samples—any two of the above in which you are interested. All we ask is that you test the samples and report results to us, asking your dealer to supply your future needs.

S. C. Johnson & Son, Racine, Wis.
"The Wood Finishing Authorities"

Coupon

Mail me Free 25c. Book and Samples

of the following:..... ....

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Name ....

Address...

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P. E.-2

Telephone Etiquette

Co-operation is the keynote of telephone success.

For good service there must be perfect co-operation between the party calling, the party called, and the trained operator who connects these two.

Suggestions for the use of the telephone may be found in the directory and are worthy of study, but the principles of telephone etiquette are found in everyday life.

One who is courteous face to face should also be courteous when he bridges distance by means of the telephone wire.

He will not knock at the telephone door and run away, but will hold himself in readiness to speak as soon as the door is opened.

The 100,000 employees of the Bell system and the 25,000,000 telephone users constitute the great telephone democracy.

The success of the telephone democracy depends upon the ability and willingness of each individual to do his part.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES

One Policy ***One System*** ***Universal Service***

ENLIST AS A LOCAL AGENT

for the Fast-Working, Fast-Selling

Oliver Typewriter!

The OLIVER RECORD HAS NEVER BEEN EQUALED

The battle lines of the Oliver Typewriter forces are forming for another campaign of conquest. The triumphs of 1910—the most brilliant ever achieved by a great sales organization—have served to inspire to more mighty deeds in the coming year.

The roll-call of the Oliver Sales Organization shows over 15,000 men **under arms**—the most magnificent body of trained salesmen in the world.

This Sales Force, great as it is, cannot cope with the tremendous increase in business which the popularity of the Oliver Typewriter has created.

Resident Agents Wanted in Every Town and Village

This advertisement is a call for reinforcements—to enable the Oliver Sales Force to extend its skirmish lines to all sections of the country.

The central idea of our selling system is to have—**everywhere**—a vigilant agent of the Oliver Typewriter constantly **on the ground.** Whether that agent devotes part or all of his time to the sale of the Oliver Typewriter is left to his own discretion.

Teachers, tradesmen, doctors, ministers, lawyers, stenographers, telegraph operators, printers, mechanics—men and women in a multitude of different occupations—can succeed as Local Agents for the Oliver Typewriter. If you have the **will** to take up this work, **we will point out the way.**

The OLIVER Typewriter

The Standard Visible Writer

The Oliver Typewriter has been breaking records since the day it was placed on the market. **Efficiency** records, **speed** records, **endurance** records—it has won them in quick succession. It sets the swiftest pace in sales by giving unparalleled **service.**

With **several hundred less parts** than other standard typewriters, its **simplicity, strength, ease of operation, versatility and convenience** are correspondingly **increased.**

"17-Cents-a-Day" Plan a Wonderful Aid to Agents

This machine, with all of its advantages, all of its time and labor-saving devices, the Local Agent can buy—**and sell**—for Seventeen-Cents-a-Day.

The Oliver Typewriter No. 5—the newest model—the $100 machine—equipped with a brilliant array of new devices and conveniences, actually offered for **pennies!**

This irresistible offer enables the Local Agent to succeed **right from the word "go"!**

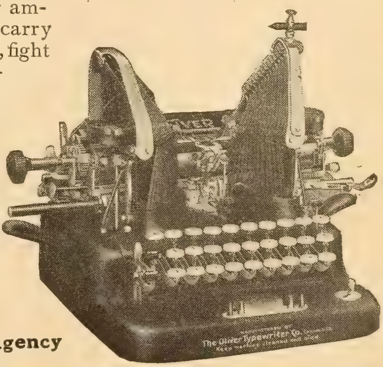
Write for Inspiring Book, "The Rise of the Local Agent"

Read the life stories of men who rose from the Local Agency ranks to positions of great importance in the Oliver Organization—How one Local Agent is today the Typewriter King of Mexico. (Mexican Government reports show that more Oliver Typewriters are imported than all other typewriters combined.)

These inspiring stories will open your eyes to the **big opportunities still open** for ambitious men to carry the Oliver flag, fight for new records and reap the rewards of success.

Send a personal letter today while the **Call for Volunteers** is ringing in your ears.

Address Agency Department.



THE OLIVER TYPEWRITER CO., 226 Oliver Typewriter Bldg., Chicago

"Economy" is but half value;

the other half—**Quality of Light**—is the service which adds full measure packed down and running over to the user of

Mazda Lamps

THE radiance of Mazda Lamps is the radiance of economy and quality—the Mazda Lamp produces 2½ times the light of an ordinary electric lamp at no greater current expense and light of purer, whiter color value.

The Mazda Lamp is a development which was placed on the market almost a year ago. The "light giving wires" in the lamp are constructed of metal instead of carbon, and since it takes two-thirds less current to heat the metal to incandescence, the Mazda Lamps give more than 2½ as much light as the ordinary—carbon—lamps for the same current. The metal "light wires" stand a greater heat and thus the light is whiter, more brilliant, and approaches daylight more closely. You can ill afford to use the old style lamps if quality or economy in lighting are of value. Mazda Lamps for all purposes may be had from any of the Member Companies of the National Electric Lamp Association.

National Electric Lamp Association

CLEVELAND

The following is a list of the Member Companies of the

National Electric Lamp Association

CLEVELAND

Call upon any of them for your lamp supplies.

THE BANNER ELECTRIC CO., Youngstown, O.

THE BRILLIANT ELECTRIC CO., Cleveland, O.

BRYAN-MARSH COMPANY, Central Falls, R. I.—Chicago, Ill.

THE BUCKEYE ELECTRIC CO. Cleveland, O.

THE BUCKEYE ELECTRIC LAMP CO., City of Mexico

THE CLEVELAND MINIA. LAMP CO., Cleveland, O.

THE COLONIAL ELECTRIC CO., Warren, O.

THE COLUMBIA INC. LAMP CO. St. Louis, Mo.

ECONOMICAL ELECTRIC LAMP CO., New York City

THE FOSTORIA INC. LAMP CO., Fostoria, O.

THE GENERAL INC. LAMP CO., Cleveland, O.

THE JAEGER MINIA. LAMP MFG. CO., New York City

THE MONARCH INC. LAMP CO., Chicago, Ill.

THE WARREN ELECTRIC & SPECIALTY CO., Warren, O.

NEW YORK & OHIO COMPANY, Warren, O.

THE SHELBY ELECTRIC CO., Shelby, O.

THE STANDARD ELECTRICAL MFG. CO., Warren, O.

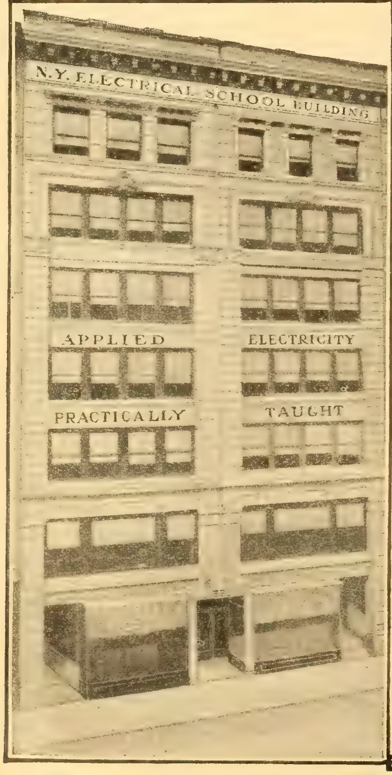
THE STERLING ELECTRICAL MFG. CO., Warren, O.

SUNBEAM INC. LAMP CO., Chicago, Ill.—New York City

THE SUNBEAM INC. LAMP CO., of Canada, Ltd., Toronto, Can.

GET THE BEST PAY

It is waiting for you in the Electrical Business



Trained Electricians are in Demand Everywhere

YOU CAN LEARN ELECTRICITY

Make a Start Now

Send in the Coupon ➡

-ING JOB IN AMERICA

ELECTRICITY is the most profitable work in America today. Electrical workers receive higher wages than those in any other industrial lines. More electrical men are rising to high positions and making fortunes than any other class. All this is due to the rapid growth in the use of electricity for power, heating, lighting and thousands of other uses.

The demand for trained electricians is heavy. An electrician doing ordinary work earns big pay. Especially good men earn high salaries and have splendid opportunities to get into business for themselves.

But to do this a man must be trained. We train men in the theory and practice of electricity. After taking a course with us, he is qualified to do all kinds and classes of electrical work.

You can learn electricity and you will do so if you want one of the best paying jobs in America. Any man or boy can learn this line of work.

The important step is to get started. Fill out the coupon below and mail it to us. We will send full information about our course in Electricity. We will tell you just how we teach Electricity, how long it will take and tell you all about the business.

Fill out the coupon and mail it to us. There is no expense or obligation. You owe it to yourself to find out about this great opportunity.

Delay is dangerous—write us at once.

New York Electrical School
40 W. 17th St., New York, N. Y.

COUPON

New York Electrical School
40 W. 17th Street, New York, N. Y.

Send full information about your course in Electricity.

Name ....

Address ....

....

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¶ Advertisements in this section of Popular Electricity will cost 5 cents per word with 5% off for 3 times, 10% off for 6 times, 15% off for 9 times and 20% off for 12 times, cash with order.

¶ In order to secure the proper classification, advertisements must be in this office the first of each month preceding date of issue.

AERONAUTICS

BLERIOT MONOPLANE—GUARANTEED Flyer, Aluminum, Bamboo, Rubber Motor! Agents wanted. Reberts, 344 Cumberland, Brooklyn, N. Y.

BUILD YOUR OWN AEROPLANE—BLUE prints and working drawings of a Curtiss, Bleriot, or an Antoinette. One Dollar. Chicago Aeroplane Mfg. Co.

MODEL BALLOONS AND FLYING MAchines. How to Make Them. By J. H. Alexander. Contains complete directions for constructing models with five folding plates of working drawings, also an account of the progress of aviation. $1.50 postpaid. Popular Electricity Book Dept.

"BOY AVIATORS' SERIES," SIX THRILLING airship books for young Americans. New, exciting and absorbing. Send for Vol. 1, and you will quickly want the others. Postpaid 50c. At all bookstores. Our immense catalogue free. Hurst & Co., 395 Broadway, New York.

AGENTS WANTED

2-TICKLE-U, 3c. STIX, STOCKTON, CAL.

See what I say under "Typewriters." ATCHISON

"AGENTS MONTHLY," 3 MONTHS SUBscription 10c. None free. P. E. Walter, 35 Dean St., Brooklyn, N. Y.

"PERFECTION POCKET ADDING MAchine—Lightning seller. Agents wanted. Cincinnati Specialty Mfg. Co., Dept. E, Cincinnati, Ohio.

DON'T ACCEPT AN AGENCY UNTIL YOU get my samples and particulars. Money-makers. Address SAYMAN, 706 Sayman Bldg., St. Louis, Mo.

AGENTS WANTED FOR BEST SELLING Storage Battery on the market. Liberal commission. Jewel Electric Co., 273 Michigan Ave., Chicago.

SELL EAGLE BRAND MENDING TISSUES—Greatest labor-saving invention. 500 per cent profit. Three samples for dime. Eagle Rubber Company, 207 East Tenth St., New York.

BOKARA DIAMONDS—AGENTS, EVERYONE wanted to wear and sell these Famous Gems. Big profits. Sample offer and catalog, Free. Northwestern Jewelry Co., 80 Northwestern Bldg., Chicago.

AGENTS MAKE BIG MONEY SELLING OUR new gold letters for office windows, store fronts and glass signs. Any one can put them on. Write today for a free sample and full particulars. Metallic Sign Letter Co., 400 N. Clark St., Chicago, Ill.

OUR ELECTRIC SPECIALTIES ARE EASY sellers and Agents' profits are big. Some choice territory still open. A penny postal will bring you full particulars. Send now. STANDARD ELECTRIC WORKS, 1200 Washington Ave., Racine, Wis.

AGENTS WANTED

AGENTS MAKE BIG MONEY—BIG PAY, NO experience, no capital required. 5,000 new art specialties, photo pillow tops 25c, portraits 30c, bromides 25c. New 1911 catalog and samples free. Write. Daniel H. Ritter Co., Madison St., Chicago, Ill.

BULLY! GREAT! IMMENSE!—THAT'S WHAT all our agents say after selling our attractive 1911 combination packages of soap and toilet articles with valuable premiums. 100 to 300 per cent profit. One Michigan agent made $65 in 47 hours; another $21 in 8 hours; another $22.50 in 10 hours; ACT NOW—NOT TOMORROW. Davis Soap Co., 27 Union Park Court, Chicago.

HERE'S A MONEY GRABBER—HAND MAchine makes $5 to $6 worth of better, stronger rope than factory for 40c, any length or thickness; saves time and money. ABSOLUTELY NO COMPETITION. Farmers, factories, liveries, saddlers, all rope users buy at sight. Absolute control of territory free to high-grade men who can handle agents; 125 per cent profit. Chicago Appliance Factories, 702 N, 21 Quincy St., Chicago.

AGENTS—BIGGEST MONEY-MAKER known. The new Canchester Incandescent Kerosene Lamp revolutionizes old lighting methods. Burns air, not money. Six times brighter than electricity, gas or acetylene at 1-10th cost. Burns with or without mantle. Burner fits any lamp. Saves 75 per cent oil. No trimming wicks. Showing means selling. Territory going fast. Write today. Handsome outfit furnished. Canchester Light Co., Dept. P. E., 1, Chicago.

AUTO ACCESSORIES

DOES YOUR MOTOR KNOCK? YOU CAN locate the trouble in a moment with the Sonoscope. Used by motor experts all over the world. Price postpaid $2.00. Circular free. Gaylor Automatic Stropper Co., Stamford, Conn

AUTOMOBILES

AUTOMOBILES—OVER FOUR HUNDRED bargains, $95.00 upward. All guaranteed! Freight prepaid! Write now for latest illustrated bulletin. MOTOR CAR EXCHANGE, Dept. A, 217 West 125th St., New York City.

BOOKS

STIX, STOCKTON, CAL.—MENDER 3c.

500 FORMULAS, BOOK FORM, 25c. GLOBE N. Co., 1745 Leavenworth, Omaha, Neb.

"THREE LITTLE BOOKS FOR LADIES," postpaid in plain cover for 25c. (They tell what you want to know.) O. K. Pub. Co., Clerk 191, Decatur, Ill.

BOOKS

TELEPHONE TROUBLES AND HOW TO Find Them, new 14th edition, price 25c, Hyde Pub. Co., Telephone Building, 183 Fifth St., Milwaukee, Wis.

IF YOU WANT BOOKS ON ANY ELECTRICAL subject write to Popular Electricity Book Dept. We can furnish any electrical book published and may be of assistance in the selection of same.

"WHITE SLAVE TRADE," EDITED BY ERNEST A. BELL, 500 pages, 30 illustrations, price $1.50 postpaid. Circular free. O. K. Pub. Co., Clerk 191, Decatur, Ill.

LEARN TO EARN—BOOKS ON MODERN subjects that show you how to do things. Catalogue free. Electrical Dictionary, 4,800 electrical definitions, 224 pages, illustrated. 25 cents postpaid. Clarence E. Hardage, Book-Monger, Syracuse, N. Y.

BUSINESS OPPORTUNITIES

See what I say under "Typewriters." ATCHISON.

300 MONEY-MAKING IDEAS AND "DIGEST" six months for 10c. Digest, Grand Rapids, Mich.

GOOD INCOME FROM SMALL INVESTMENT, dip-plating knives, forks, spoons, etc. Write for particulars. Rogers Metal Co., Kansas City, Mo.

$100 MONTHLY AND EXPENSES TO TRUSTworthy men and women to travel and distribute samples: big manufacturer. Steady work. S. Scheffer, Treas., MM 174. Chicago.

START LEGITIMATE MAIL-ORDER MERcantile business; possibilities unlimited, conducted by anyone. We print catalogs, supply merchandise at wholesale. Booklet and sample catalog free. Central Supply Co., Kansas City, Mo.

MOTION PICTURE MACHINES, FILM Views, Magic Lanterns, Slides, and similar Wonders For Sale. Catalogue Free. We also buy Magic Machines, Films, Slides, etc. Harbach & Co., 809 Filbert St., Philadelphia, Pa.

START IN THE MAIL-ORDER BOOK BUSIness! We can show you a proposition enabling you to make 88c profit on a dollar, yet give your customer $3.00 value. Another proposition shows 95c profit on every dollar order. Business can be operated in your spare time. If you are handling any other line you can include some of our circulars without extra expense to you. We will send you one of our regular dollar samples and full particulars upon receipt of 10c. An opportunity is offered you here to get into a big paying business. STANLEY J. MORGAN CO., 3453 N. Hamilton, Chicago.

MAKE METAL POLISH, FURNITURE POLish, Silver Polish, Stove Polish, Shoe Blacking, etc. Small investment, large profits, also practical working formulas for Paints, Varnishes, Linseed Substitutes, Turpentine Substitute, Specialties. For particulars write, CANADIAN FORMULA BUREAU, 69 Adelaide East, Toronto, Canada.

WE START YOU IN A PERMANENT BUSIness with us and furnish everything. We have new easy selling plans and seasonable leaders in the Mail Order line to keep our factories busy. No canvassing. Small capital. You pay us out of the business. Large profits. Spare time only required. Personal assistance. Write today for plans, positive proof and sworn statements. J. M. Pease Mfg. Co., 1185 Pease Bldg., Buffalo, N. Y.

BUSINESS OPPORTUNITIES

MAKE MIRRORS AT HOME. BIG PROFITS with little outlay. One 18x36 in. mirror, costs $2.00 to $5.00. You can silver a glass this size for 20c. Send $1.00 in stamps or money order and we will send you EXPLICIT DIRECTIONS how to do it; also how to emboss, grind, foil, gold leaf, frost chip, and make imitation stained glass. How to transfer photos on glass, bore holes in glass and cut skylights. George L. Patterson & Co., Dept. 4, Brooksville, Ky.

COINS AND STAMPS

STAMPS—200 ALL DIFFERENT 10c. COINS—10 all different, 15c, large U. S. Cents, 5c. F. L. Toupal Co., Chicago Heights, Ill.

500 MIXED FOREIGN, CHILI, AFRICA, Russia, Japan, etc., 12 cents. 1,000 mixed old United States, 25 cents. Stamps bought, list 4 cents. Kleinman Stamp Co., 3643 N. Marshall St., Philadelphia, Pa.

$7.75 PAID FOR RARE DATE 1853 QUARTERS. $20.00 for a Half-Dollar. We pay a cash premium on hundreds of old coins. Keep all money dated before 1884, and send 10 cents at once for our New Illustrated Coin Value Book, 4x7. It may mean your fortune. Clarke & Co., Coin Dealers, Dept. 83, Le Roy, N. Y.

ELECTRIC MATERIAL

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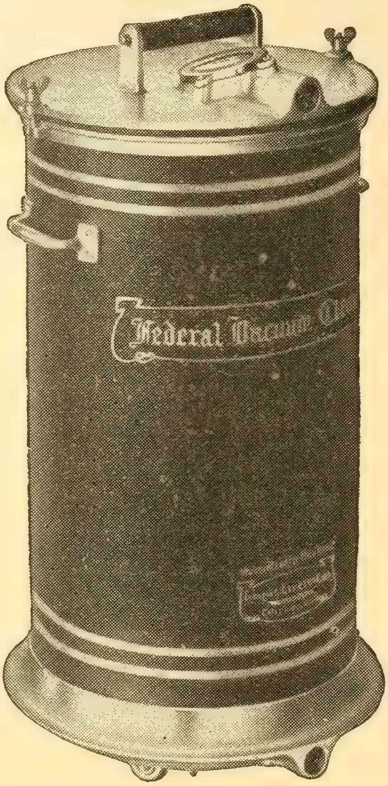

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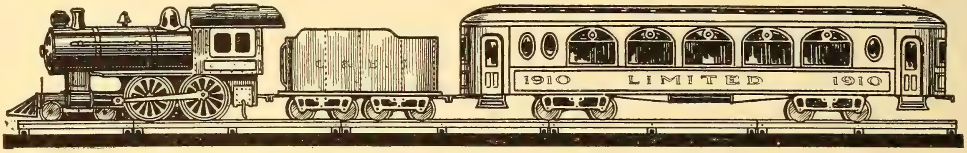

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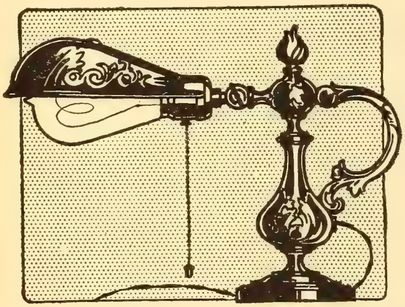

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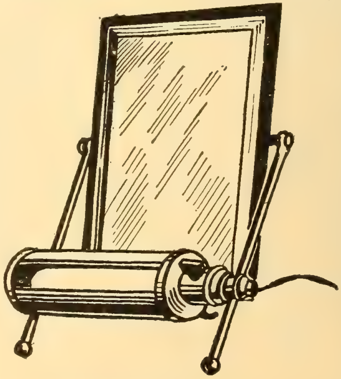

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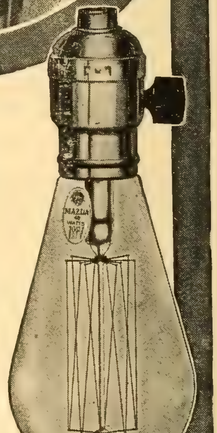

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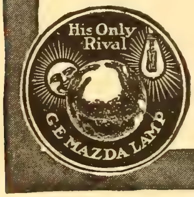

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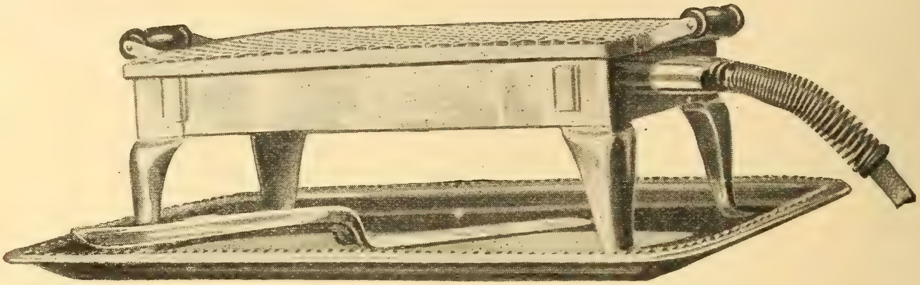

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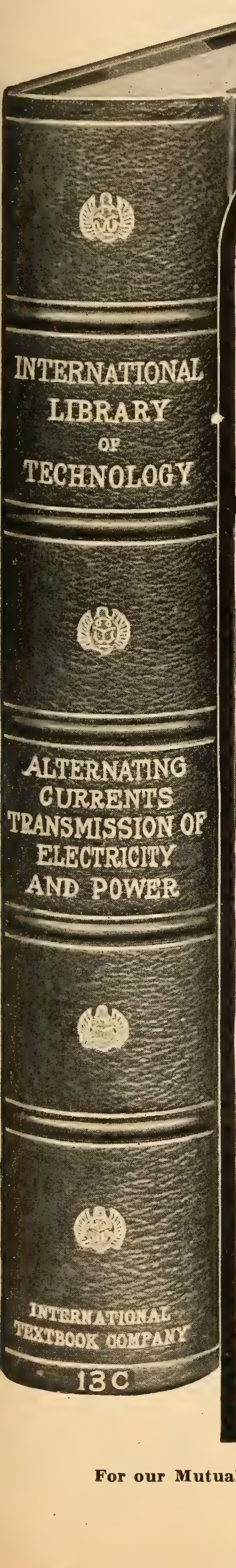
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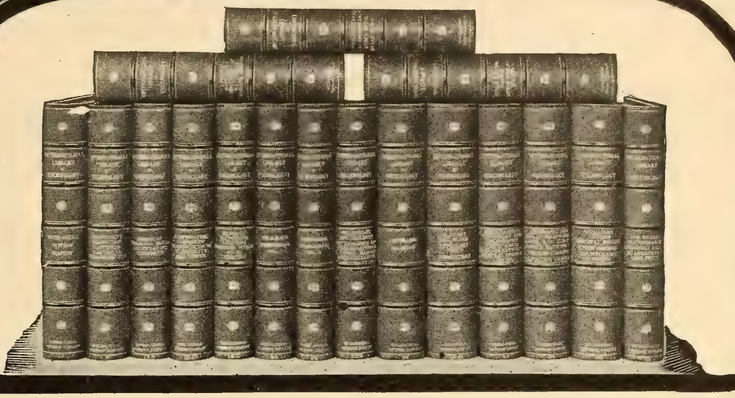

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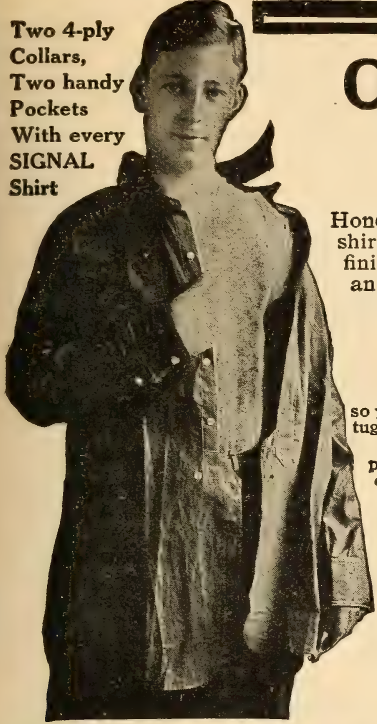

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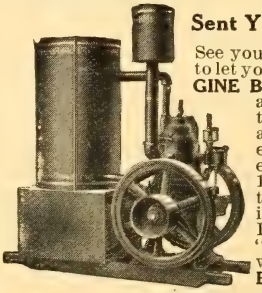

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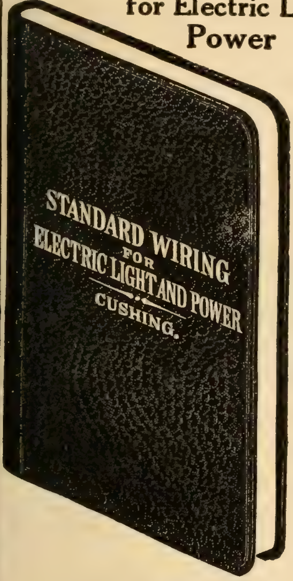

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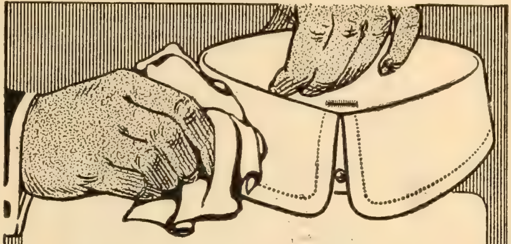

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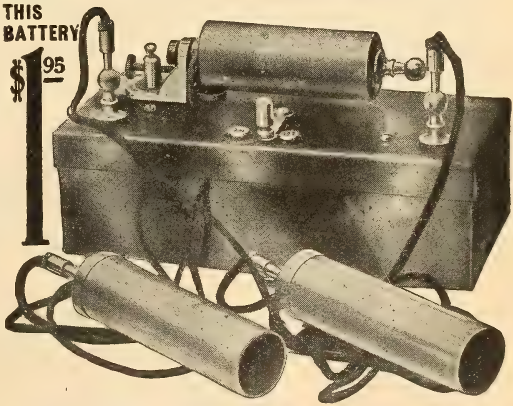

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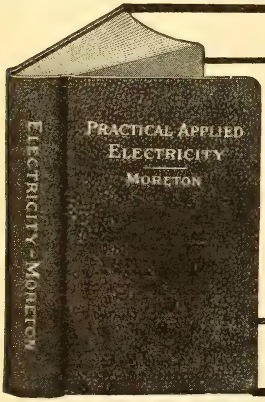

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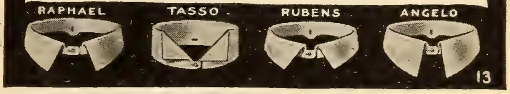

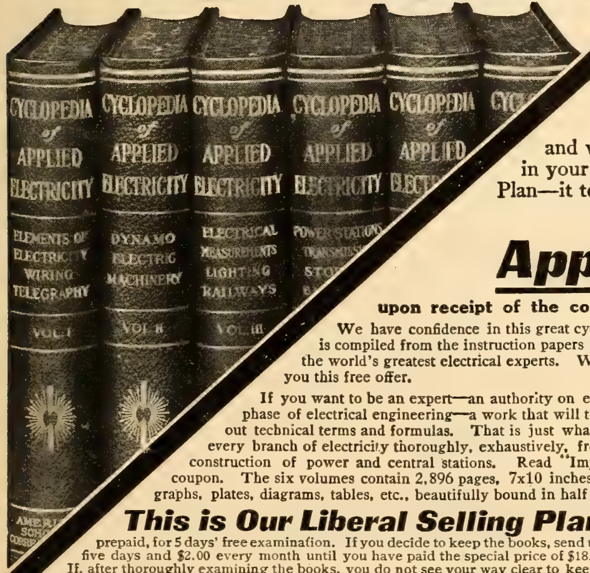
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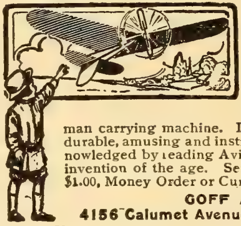

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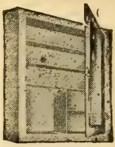

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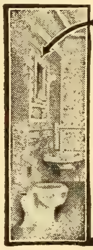

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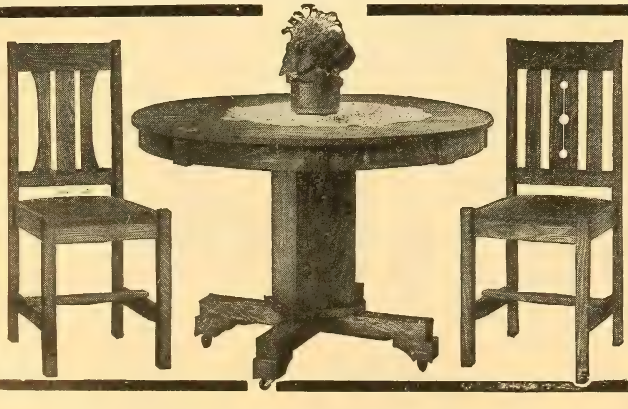

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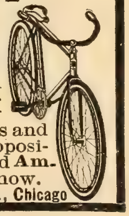

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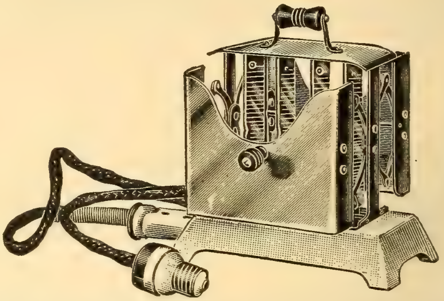

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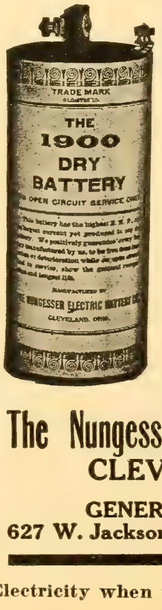

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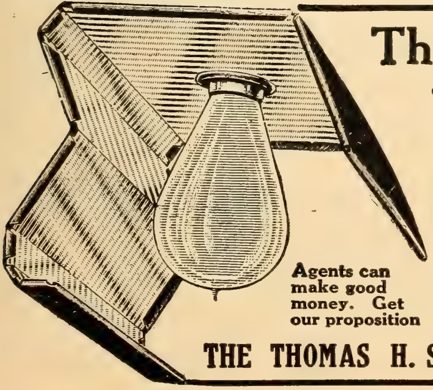

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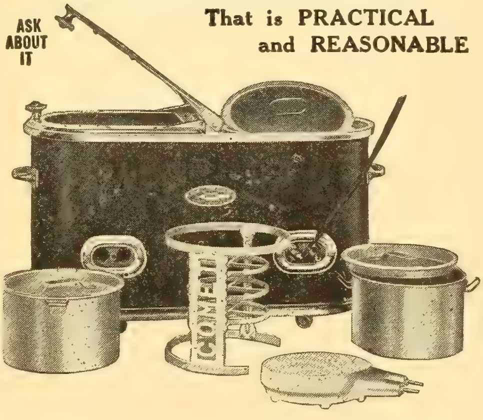

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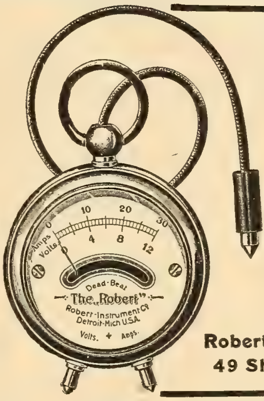

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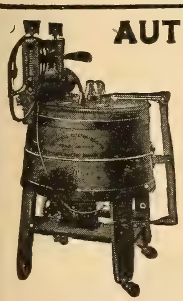

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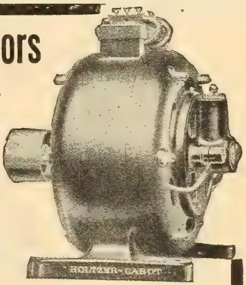

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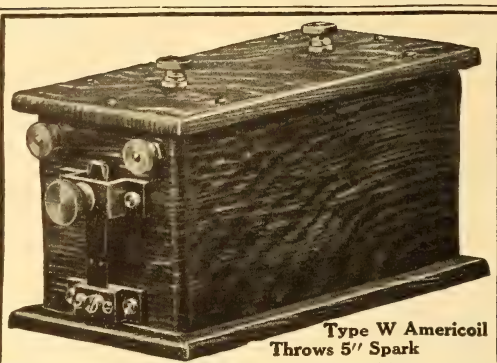

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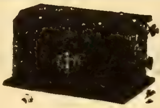

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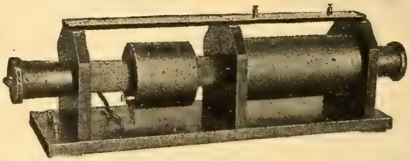

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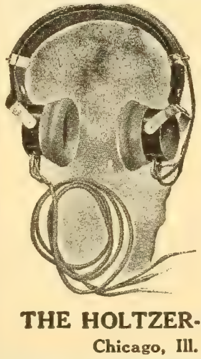
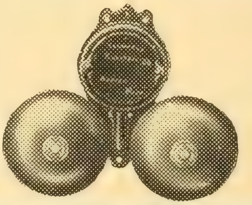


Wireless Receivers

Our long experience in manufacturing all kinds of receivers for telephone use, has made us specialists in WIRELESS RECEIVER work. Our special magnet steel, sensitiveness of operation, durable construction, places our wireless receiver set far ahead of anything manufactured in the country.

Mention Popular Electricity when writing.

THE HOLTZER-CABOT ELECTRIC CO.
Chicago, Ill. Brookline, Mass.



MAKE EASY MONEY INSTALLING

SCHWARZE ELECTRIC BELLS

They cure all Bell troubles and save their cost. For any current. Send $1.50 today for sample silver-toned house bell, all charges prepaid anywhere in the United States.

SCHWARZE ELECTRIC CO.
5 Main St., ADRIAN, MICH.

MURDOCK WIRELESS APPARATUS

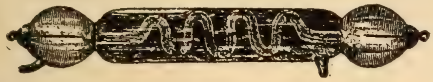
CAN YOU READ

distant stations with clear cut tones in your receivers? No station is getting the limit without sensitive phones. Murdock-made receivers assure successful stations. They are sensitive, strong, simple, tested for pitch, under actual working conditions and proved for efficiency before shipment. Priced from $2.70 to $15.00. Send for descriptive circular.

WIRELESS EQUIPMENT FOR ALL PURPOSES.

WM. J. MURDOCK CO.
50 Carter St., Chelsea, Mass.
162 Minna St., San Francisco **221 S. Clinton St., Chicago**

"BROOKLYN WIRELESS," MARK OF QUALITY . . . . SUFFICIENCY



GEISSLER TUBES, like cut, with liquid, 2 in	$ .25
"BWAENCO" SPARK GAP. (Improved), this month	.35
Aluminum Helix or Aerial Wire, per pound	.50
Enamelled Wire, No. 18-22, per pound	.50
Bare Copper Wire, No. 8-14, per pound	.40
"BWAENCO" Non-Inductive Potentiometer	.75
"BWAENCO" Tuning Coils, Double Slide	1.50

BROOKLYN WIRELESS CO., Inc., 766 Broadway, Brooklyn, N. Y.

Belden Magnet Wire

Our SILK and COTTON covered MAGNET WIRE is accurate to gauge with insulation of perfect uniformity and continuity and is put up one piece only per spool.

Beldenamel Magnet Wire is insulated with several layers of tough elastic enamel separately applied and baked onIt possesses the highest insulating strength and will not become brittle and flake off.

We quote the following net prices to readers of this paper and will ship postage or express prepaid on receipt of cash. **No orders filled amounting to less than $1.00.**

Prices are per pound.

Size	Single Cotton	Beldenamel	Single Silk	Double Cotton	Double Silk
16			.48		.61
17			.49		.62
18			.50		.64
19			.52		.65
20	.35	.48	.53	.38	.67
21	[illegible]6	.49	.54	.42	.69
22	[illegible]7	.51	.55	.44	.73
23	.39	.53	.58	.47	.77
24	.41	.56	.61	.50	.83
25	.44	.60	.66	.55	.89
26	.48	.66	.72	.60	.99
27	.52	.71	.78	.66	1.11
28	.55	.77	.84	.72	1.20
29	.59	.84	.92	.78	1.33
30	.65	.93	1.02	.85	1.54
31	.74	1.06	1.15	.92	1.85
32	.77	1.19	1.30	.98	2.04
33	.86	1.35	1.48	1.13	2.40
34	1.04	1.60	1.74	1.32	2.76
35	1.12	1.86	2.03	1.60	3.17
36	1.27	2.16	2.35	1.80	3.59
37	1.62	2.56	2.80	2.58	4.42
38	2.16	3.07	3.35	3.42	5.06
39	2.82	3.72	4.05	4.32	5.85
40	3.60	4.48	4.88	5.40	6.92

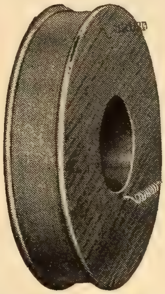
Belden Mfg. Co., 2306 S. Western Ave.
CHICAGO, ILL.

WIRELESS APPARATUS

Our Wireless Goods are the best on the market, and are guaranteed to *work.* Our instruments are made of the finest materials, and are sold at present at a price within the reach of every experimenter. Send 2c stamp for our large catalogue which contains a full list ot Wireless Instruments, Novelties and Electrical Goods, and also a great deal of Wireless information for the Wireless experimenter.

The I. W. T. Wireless Co., 726½ Broadway, Brooklyn, N. Y.

SECONDARY "UNITS"



Been having trouble winding your Secondary for your Induction Coil or Transformer? Why not put your worries on our shoulders? The winding is not a WORRY to us, as we have the equipment, and winding coils is a part of our BUSINESS.

Our Secondary "UNITS" are wood spool sections wound, parafined, etc., and all ready to connect up. You can buy a spool at a time or as many as you want, and they will cost you but little more than the wire alone,

Send 2-cent stamp for our large catalogue which tells all about it and many other things "WIRELESS" besides.

Dawson & Winger Electric Co.
429 Dearborn Street: Chicago, Ill.

NEW WIRELESS WONDER

Aero-Field Receiving Outfit. Weight only 4 oz. Receives up to 75 miles. The Wireless Sensation of the year. Consists of 1000 Ohm, receiver and attachments all assembled on regular size leather insulated head band. Price $4.00 (not including light field aerial). A wonderful instrument at a wonderful price. Boy scouts and all requiring light outfits send 2c for description of the Aero and catalogue. **Etheric Electric Co.,** Salesrooms and Factories, 278 Lenox Ave., cor. 124th St., 71 Barclay St., New York, N. Y.

10 AMP.-HOUR STORAGE CELL

PRICE $1.00

The most durable and reliable battery made. Your Wireless Set will send signals from 25-30 per cent. farther when these Storage Cells are used in lieu of other forms of battery. We also **MANUFACTURE** a complete line of Wireless Telegraph and Telephone Apparatus, Dynamos, Motors, Rectifiers, Transformers, Gasoline Engines, Model Aeroplanes, etc. Send 2c stamp for descriptive matter.

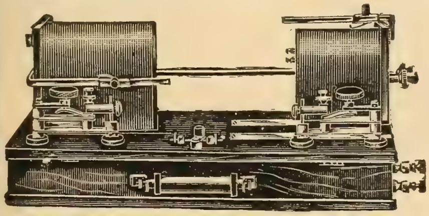
ADAMS-MORGAN CO.
"The Experimenter's Supply Co."
Box 72a Upper Montclair, N. J.

Beware of Imitators

Owing to the great success of my **Improved Navy Wireless Receivers** for long distance work, some concerns are misrepresenting them. The receivers I make have my name on them. **Look for it.**

Send for new catalog and testimonials.

C. BRANDES, 111 Broadway, New York
San Francisco Agent:
C. F. King, 163 Belvedere Street.



No. 6040, price - - $40.00
Complete Set, unmounted 29.00

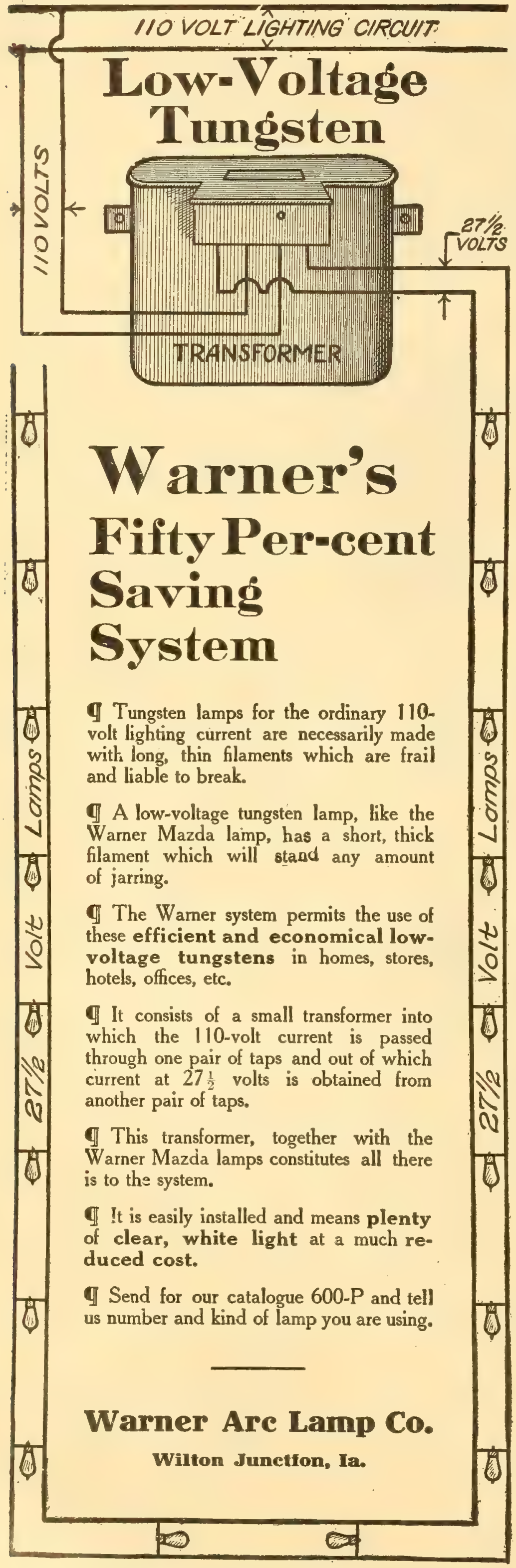
BIG 200 Page Electrical Catalog

The Greatest Line of Wireless and Electrical Goods Extant

Send 4c stamp (to cover postage only) for this catalog, deducting same, if desired, from first order.

One of our patrons from California voluntarily writes as follows: "I think that it is only right for me to express my appreciation to you for the receiving set No. 6040 that you supplied me with some two weeks ago. I have never seen anything that can be compared to it. **I have received messages from stations sixteen hundred miles distant,**—on three occasions **I picked up Honolulu in the Hawaiian Islands** and heard signals very clearly," etc.

J. J. DUCK, 428 St. Clair Street **TOLEDO, OHIO**



Low-Voltage Tungsten

Warner's Fifty Per-cent Saving System

¶ Tungsten lamps for the ordinary 110-volt lighting current are necessarily made with long, thin filaments which are frail and liable to break.

¶ A low-voltage tungsten lamp, like the Warner Mazda lamp, has a short, thick filament which will stand any amount of jarring.

¶ The Warner system permits the use of these **efficient and economical low-voltage tungstens** in homes, stores, hotels, offices, etc.

¶ It consists of a small transformer into which the 110-volt current is passed through one pair of taps and out of which current at 27½ volts is obtained from another pair of taps.

¶ This transformer, together with the Warner Mazda lamps constitutes all there is to the system.

¶ It is easily installed and means **plenty of clear, white light** at a much reduced cost.

¶ Send for our catalogue 600-P and tell us number and kind of lamp you are using.

Warner Arc Lamp Co.
Wilton Junction, Ia.

Have you a Little Junior in Your Home?

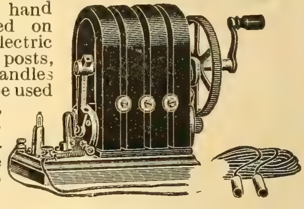
For residence door bells, buzzers and all classes of light work the Junior Type

Thordarson Bell-Ringer

develops more power from less current than any other transformer on the market. Get rid of the battery nuisance. Can't burn out if short circuited. Price $3.00. Get it from your Electrical Jobber or direct from us.

THORDARSON ELECTRIC MFG. CO.
220 South Jefferson Street CHICAGO

A Pleasing Gift For Boys



Large powerful hand Dynamo, mounted on oak base with electric lamp, connecting posts, and cord with handles for shocks. Can be used for ringing bells, lighting lamp, etc.

Something practical and durable and guaranteed to be perfect.

Send order today as we have a limited supply.

PRICE COMPLETE, ONLY $3.00

HOLTZER-CABOT ELEC. CO.
6161-65 S. State Street CHICAGO, ILL.

HESS Sent on Approval FURNACE

No.45 "Leader" Hess Steel Furnace Price $49
Delivered East of Omaha and North of Ohio River
Pipes and Registers Extra

We will deliver a complete heating equipment at your station at factory prices and wait for our pay while you test it during 60 days of winter weather.

The entire outfit **must satisfy you** or you pay nothing. Isn't this worth looking into? Could we offer such liberal terms if we didn't know that the **Hess Furnace** excels in service, simplicity, efficiency, economy?

We are makers—not dealers—and will save you all middlemens' profits. No room for more details here. Write today for **free** 48-page booklet which tells all about it.

Your name and address on a post card is sufficient.

HESS, 912 Tacoma Bldg., Chicago

KEEP THE FACTORY RUNNING
BUT IF YOU HAVE A BREAKDOWN
CHEER UP!! AND WIRE ME—
I HAVE
MOTORS TO RENT
• FOR IMMEDIATE SHIPMENT •
MACHINES SHIPPED ANYWHERE IN THIS COUNTRY OR CANADA ON RENTAL WITH PRIVILEGE OF PURCHASE

I HAVE access to the largest stock of electric motors and generators in America and can furnish ALL SIZES, from one horse-power up to a five hundred horse-power machine, IMMEDIATELY FROM STOCK. State voltage and whether direct current or alternating current, single phase, phase, or three phase is desired.

Sales Manager, Gregory Electric Company, Chicago

Stop Paying for Marine Engine Experiments

Reputable agents wanted to handle popular-priced marine engine. **Absolutely guaranteed for 5 years. Thirty days' trial by the purchaser. Your money promptly refunded, without question, if you are not fully satisfied.**

A sure favorite and quick seller. Big returns assured. Simplicity the keynote of construction.

Just the engine you have been looking and waiting for. Combines the good features of the best, with all the bad ones eliminated.

Fool-proof. As near perfect as anything mechanical can be produced.

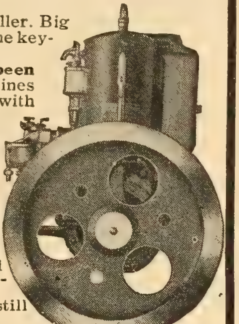
All sizes in stock from 2 to 50 h. p. Ready to ship on 24 hours' notice if necessary.

Details of the greatest selling plan and agents' money-making proposition ever offered.

Liberal discount, specified territory and absolute protection to accepted agents.

Some very productive territory still open.

Write today for Catalog No. 28 [106]



COLUMBIA ENGINE COMPANY
Cor. Jefferson and Bellevue Aves., DETROIT, MICH.

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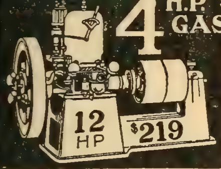
4 H.P. STATIONARY GASOLINE ENGINE COMPLETE $76⁰⁰



For Farmwork, Irrigation or Pumping, Factory use and Electric Lighting.

3 to 20 h.p.—perfectly governed—guaranteed by a responsible firm. Write for full description.

GRAY MOTOR CO., 128 Leib St., DETROIT, MICH.

ENAMEL INSULATED ~ FRENCH Feval PROCESS ~ MAGNET WIRE

ENAMEL WIRE is supplanting silk and cotton covered because **The Insulation is better,** because **It requires less space,** because **It is cheaper.**

FEVAL WIRE has a dielectric strength in excess of 75 volts per .0001 inch of insulation. The evenly distributed enamel covering adheres tenaciously yet is resistant and elastic, never cracking. No change at 400° to 500° F. All sizes, Nos. 16 to 40.

MANUFACTURERS: We have an attractive contract proposal to offer covering your requirements for 12 months.

INDIVIDUALS: We will furnish small quantities for spark coils and magnets.

FEVAL ENAMEL INSULATED WIRE CO.
129 N. Curtis Street CHICAGO

Make Your Own Electric Light

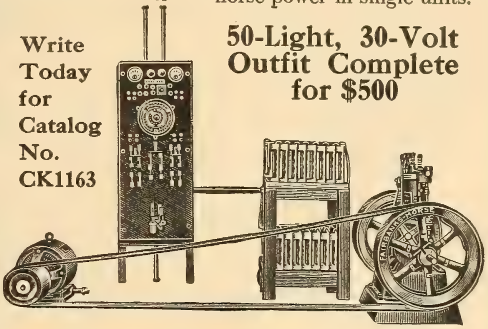
¶ We furnish you with complete outfit. Makes a brilliant light at the mere cost of generating current. Ideal for country and suburban homes, barns, factories or wherever a clean, convenient light is desired.

¶ Thoroughly practical—absolutely safe and sanitary.

¶ The same engine can be used for operating a water supply system or other machinery. We also make larger electric light plants up to 500 horse power in single units.

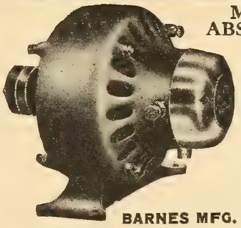
Write Today for Catalog No. CK1163

50-Light, 30-Volt Outfit Complete for $500



Fairbanks, Morse & Co.
481 Wabash Avenue Chicago, Ill.

$1/12$ AND $1/8$ Direct and Alternating Current Motors
VARIABLE SPEED - SINGLE PHASE



MOTORS THAT WILL ABSOLUTELY NOT HEAT

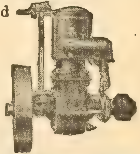
"The Barnes Motors" are especially adapted for Washing Machines, Vacuum Cleaners, Air Purifiers, Ventilating Devices, Coffee Mills, Meat Choppers, Printing Presses, etc., etc.—Dental and Medical work a specialty. Positively the best motor for use where motor driven work is necessary—greatest power, highest efficiency. We want Reliable Agents everywhere—write at once for prices and catalog. Let us figure on your requirements.

BARNES MFG. CO., SUSQUEHANNA, PA.

"Runs Like A Scared Rabbit"

Writes Cleburne Grady, Montgomery, Ala., who while yet a green hand at motors averaged 12.92 miles per hour on a 8.62 mile river trip.

Perfection Marine Motor



The "Perfection" is so worthy of the name it needs little attention. Just a regular flow of gasoline and a good spark will keep it working on hard towing, ferrying or pleasure jaunts—and it will last as long as the boat. We build 2, 2½, 3½, 4, 6 and 8 H. P. in the single cylinder and 8 to 30 H. P. in the two, three and four-cylinder engines. Prices range from **$40** to **$450** according to type and horse power.

Write for catalog. **CAILLE PERFECTION MOTOR CO.,** 106 Caille St., Detroit, Mich.

Send for our Stationary Kerosene Engine Catalog if interested

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ELECTRIC LIGHT and POWER for the Country and Farm Home

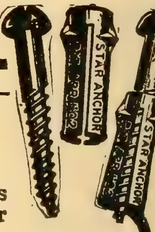
Do You Want Electric Light or Power for Your Country Home or Farm?

If you are out of reach of central station current and wish to install a gas engine electric outfit, either with or without storage battery, write for our Handbook, here illustrated. Alamo Electric outfits are standard. Our prices are as low as consistent with high-grade machines suitable for permanent installations. Investigate our proposition, it places you under no obligation.

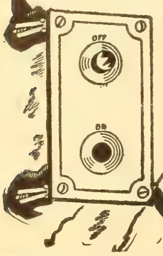
THE ALAMO MANUFACTURING CO., 73 South St., Hillsdale, Mich.

Alamo-Westinghouse Low Voltage Storage Battery Outfit

For Fastening Electrical Fixtures



Anywhere an ordinary bolt or screw is unsafe—in a tile, brick, stone or concrete wall—for fastening push bells, motors, and every electrical fixture, you will find



STAR SCREW ANCHORS

invaluable. A quick, easy, absolutely dependable means of fastening, twice as cheap and ten times more efficient than the old methods of wood plugging or "working in" with lead.

We'll trade a new catalogue number 10 and free working samples for your name and address. A postal now.

STAR EXPANSION BOLT CO.
Catalogue Dept. 10, 147-149 Cedar St., NEW YORK CITY, N. Y.

Extension Bit Holder No. 5

This Extension is made to follow a ⅝-inch bit into a hole. The four jaws are made from one piece of steel and are solid at base in their finished state.

The tool is strong and the grip on the shank to bit positive. Therefore there is no danger of losing the latter between partitions. Electricians will appreciate the value of this Extension. It is made in lengths of 12, 15, 16, 21 and 24 inches.

Ask for our catalogue showing a variety of useful tools.

MILLERS FALLS CO., 28 Warren Street, NEW YORK

5

K L E I N T O O L S
EST. 1857
TRADE MARK REG.

TRADE MARK

We now stamp all genuine Klein Tools with this Trade Mark

Tools of Merit

Worthy of

Your Attention

Your Money

is safely invested, so far as tools are concerned. If they are modern and eliminate waste. If they are practical and facilitate progress. If they are substantial and insure long usefulness.

"KLEIN TOOLS" embody these qualities.

Write for free Booklet, or send 4c in stamps for illustrated catalog.

Mathias Klein & Sons, Station U-3, Chicago, Ill.

CONVENIENT MONTHLY PAYMENTS

Send No Money With Your First Order—Buy Better Furniture Direct From My Factory—Save 15-40%

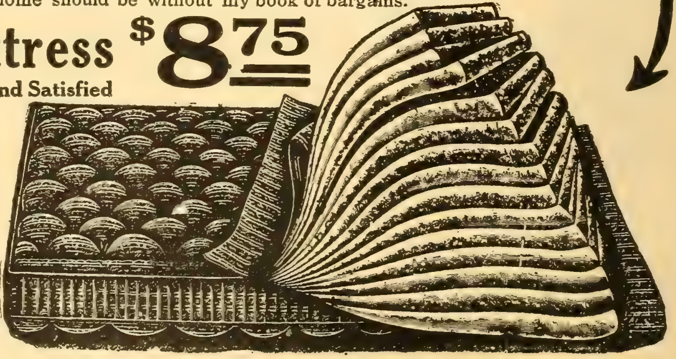
I HAVE convinced thousands that my plan—"Selling home-furnishings direct from my factory"—means a saving of 15-40% to them. I sell at factory wholesale prices. I agree to send you better furniture—Better in quality—Better in style—Better in finish, and better in everything that means high degree, and you can pay for anything you order from my factory by sending very small monthly payments. To prove all I claim, I am willing to ship on approval—No advance payment. You receive the shipment and after careful examination of the articles, if satisfied, send only the very small required amount.

Send For My Big Book of Furniture and Rug Bargains

It is free—and worth many dollars to you when you are thinking of purchasing home furnishings. It will tell all about my "Factory-to-Customer Plan." It pictures and describes hundreds of useful things for your home. Each article is fully guaranteed. No home should be without my book of bargains.

Leath Felt Mattress $8.75

$1.00 per Month When Received and Satisfied



This mattress is a good example of my high quality at a low price—other dealers would ask $14.00 for the same quality. It is made of many beautiful layers of fine quality cotton felt—will not mat—Construction the best—Ticking fine quality—Guaranteed to meet with your entire approval, like every other article as shown in my big book. Send today for a copy. Address

Arthur Leath, Pres. and Gen'l Mgr.

A. LEATH & CO.
6010 Grove Ave., Elgin, Ill.

FREE TRIAL for 6 Months

We want you to grind your tools on this perfected carborundum grinder for six months so you can find out its great value in your work. If after six months' trial you decide not to keep it, return it to us—no hard feelings, just send it back. The six months' use will have cost you nothing.

Mechanic's Special with Twist Drill Grinding Attachment

Luther Diamond Tool Grinder The Perfected Carborundum Sharpener

25 times faster than grindstones

6 times faster than emery

25 Times Faster Than Grindstones

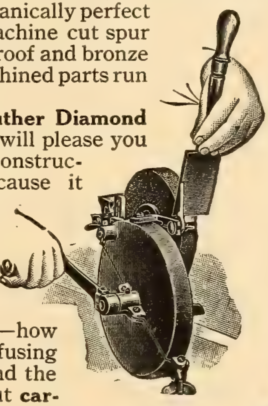
This **Luther Grinder** — the standard of the world — with its wheels of the wonderful abrasive **carborundum,** is 25 times faster than grindstones. It cuts the hardest steel as emery does copper. One man with the Luther does the work of 20 men with any other sharpening device. Does not draw temper. No need of hard pressing — just a light touch — the hard, sharp carborundum crystals of the wheels peel off steel in tiny shavings. No water needed.

Foot and Hand Power Equipped with Sharpening Attachments

The special sharpening attachments enable anyone to do the most difficult sharpening, such as sharpening twist drills, chisels, plane bits, etc.

Luther Diamond Tool Grinders are the standard grinders of the world. In addition to their wonderful carborundum wheels, that never need dressing, they are mechanically perfect machines—machine cut spur gears—dust proof and bronze bearings—machined parts run in bath of oil.

In short, a **Luther Diamond Tool Grinder** will please you by its solid construction, and because it makes it easy to have keen edged tools without drudgery.



Hand Power Mechanic's Special with Attachment

Return This Coupon and get our 6 months Free Trial Offer

Send for our 6 months' free trial offer—we will also send you free a booklet telling the interesting story of the discovery of carborundum—how a scientist, attempting to make artificial diamonds, and fusing the elements of diamonds in an electric furnace, hot beyond the measurements of science, discovered, not the diamond, but **carborundum**—the wonderful abrasive that will scratch the diamond itself and cut steel as emery does copper.

Send coupon for our 6 months' free trial offer today.

Sending this coupon puts you under no obligations. Fill in your name at once and return coupon **now** while it is on your mind.

LUTHER GRINDER MFG. CO.
62 Madison Street
MILWAUKEE, WIS.

LUTHER GRINDER MFG. CO.
62 Madison St., MILWAUKEE, WIS.

Please send me free and prepaid your free carborundum booklets and your six months free trial offer on the Luther Diamond Tool Grinder Mechanics' Special.

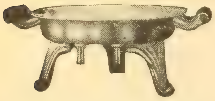
Name.................................... Address ....

Dealer's Name.............................. Dealer's Address.................................

CUTLER-HAMMER

Electric Heating Devices

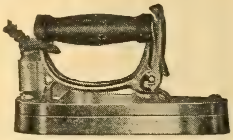
Turn the current into a Cutler-Hammer Iron for about five minutes; turn it off and 10 or 15 minutes later, wet your finger, touch any part of the ironing surface and hear it sizzle. Cutler-Hammer Irons retain their heat, iron quickly and economically. Household Irons made in 5, 6 and 7 pound sizes.


DISC STOVE
Useful for many purposes

CURLING IRON HEATER

Every up-to-date drug store, bar, restaurant, etc., should have a Cutler-Hammer Water Heater. Our Curling Iron Heater can be used to heat two irons at one time. Current flows when an iron is inserted in heating chamber and stops automatically when it is withdrawn.

ELECTRIC WATER HEATER
4 Quart Size


SLEEVE IRON—3 lb.
Convenient for travelers

Our 32-page booklet sent on request

The Cutler-Hammer Mfg. Co.
Milwaukee, Wisconsin

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PITTSBURG: Farmers' Bank Building
PHILADELPHIA: 1207 Com. Trust Building
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BOSTON: 176 Federal Street
CLEVELAND: 1108 Schofield Building

PACIFIC COAST AGENTS:
Otis & Squires, 155 New Montgomery St., SAN FRANCISCO

An Electric Toaster, Made to Sell at a Reasonable Price and to do the Work of the Most Expensive

You don't have to invest the price of a good stove to toast toast. Buy a Millar Toaster. Its made and sold to meet the needs of everyone who has current Convenient and economical.

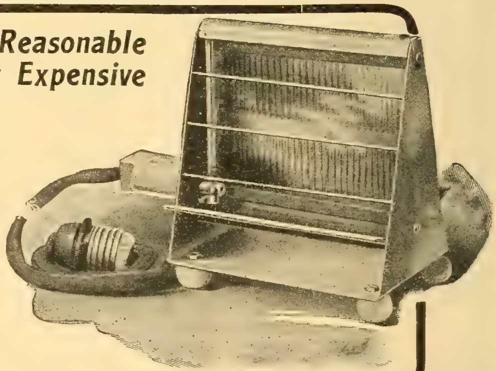
Set it in your parlor or in your dining room—its ornamental as well as useful.

The handiest utensil for light lunches, after theater parties—ready any time, anywhere, where you have electric current.

Ought to be part of your summer home equipment. Use it in light housekeeping. When traveling its indispensable.

Ask about THEM right away—send now.

Your dealer has them. **Price $3.00.**



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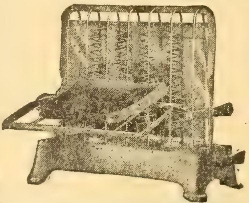

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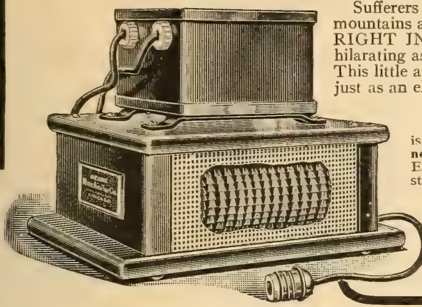

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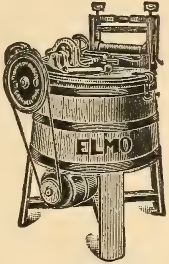

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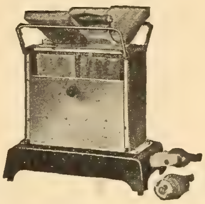

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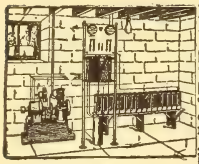

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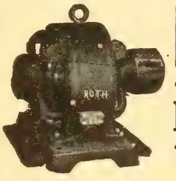

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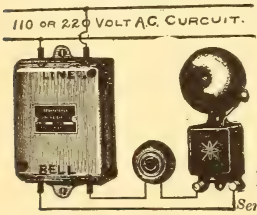

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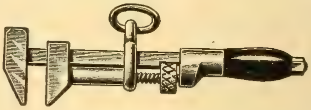

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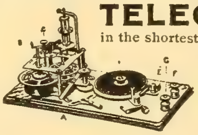

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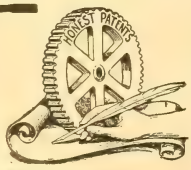

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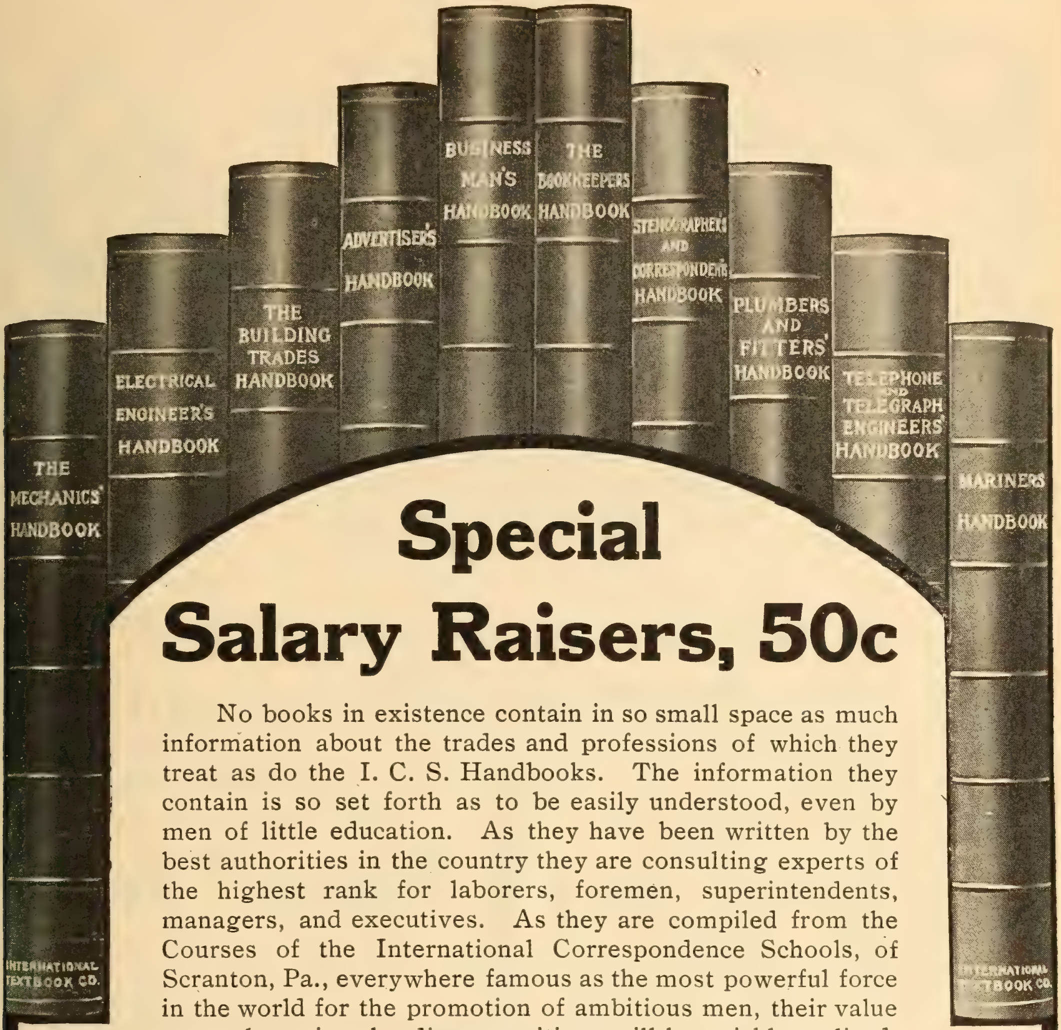
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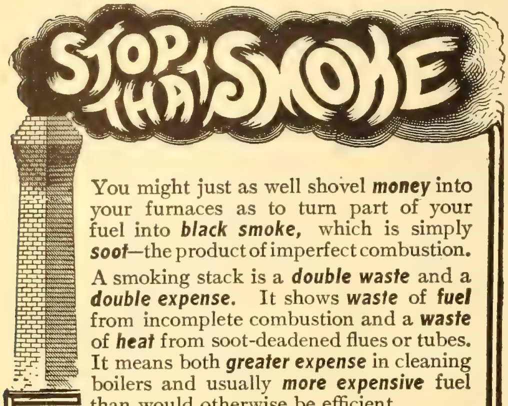

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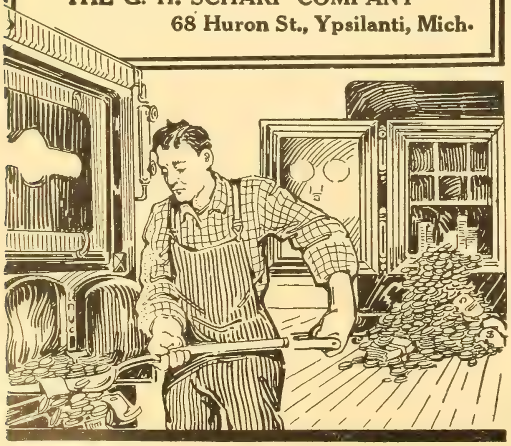

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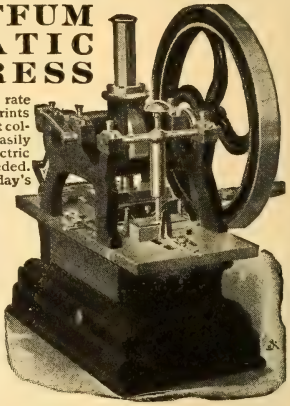

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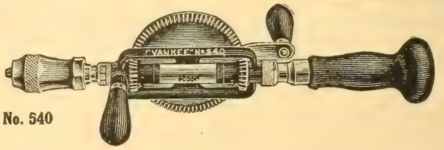
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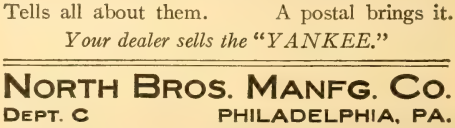
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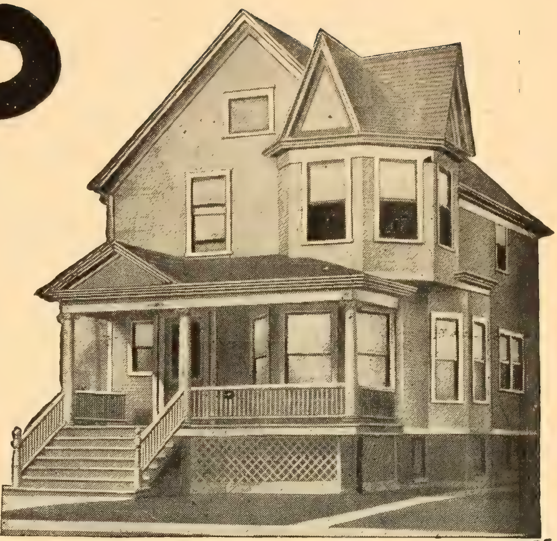

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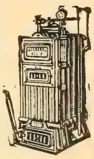

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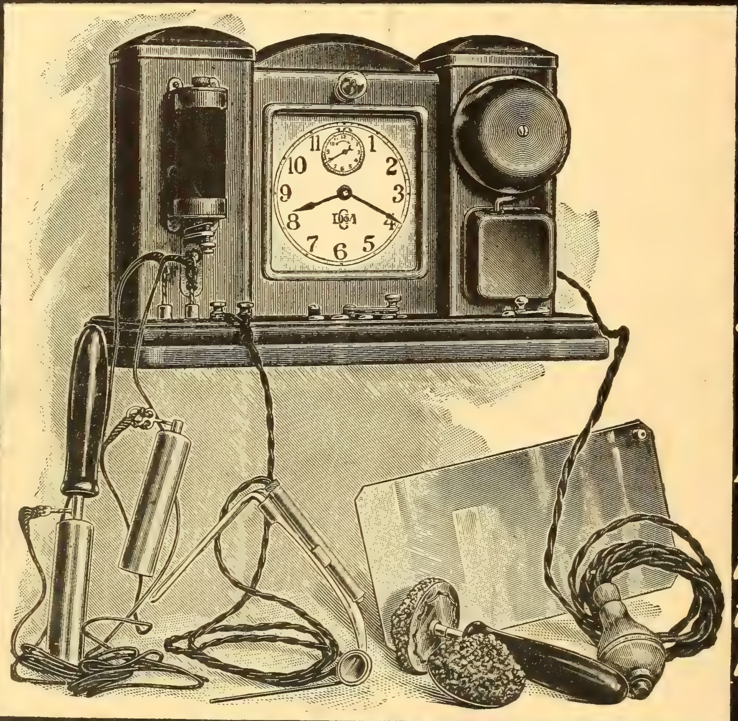

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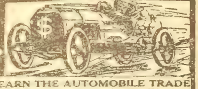

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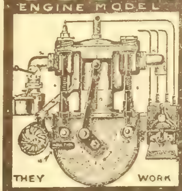

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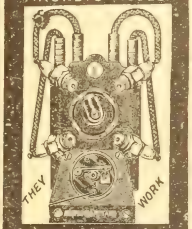

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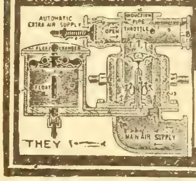

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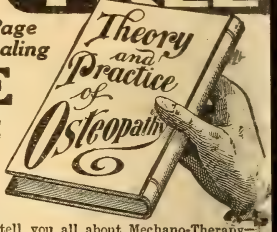
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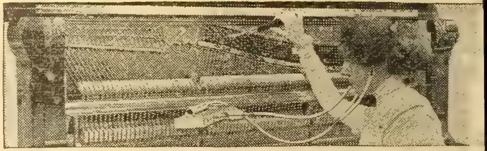

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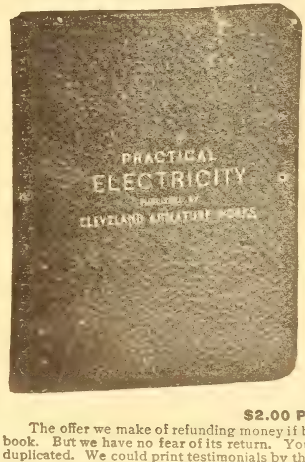

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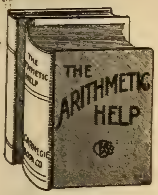

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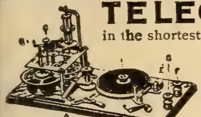

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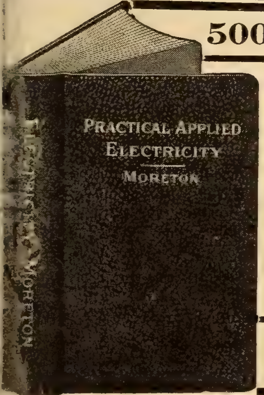

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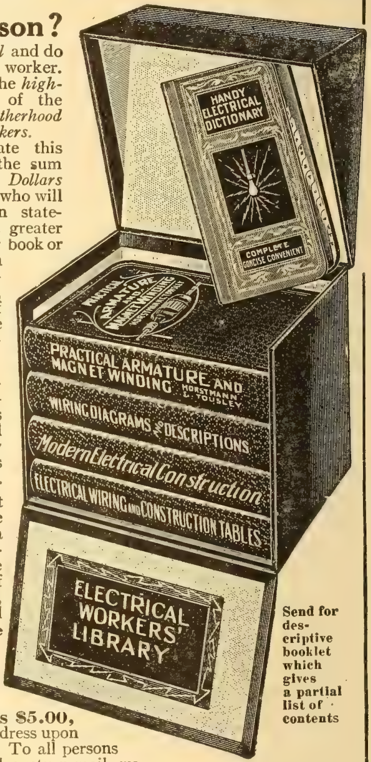
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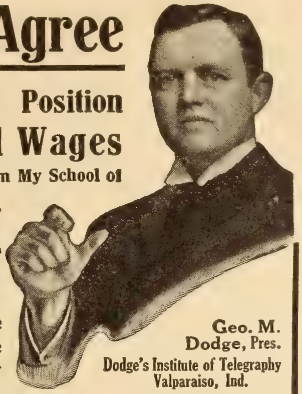

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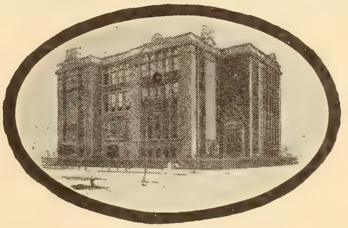

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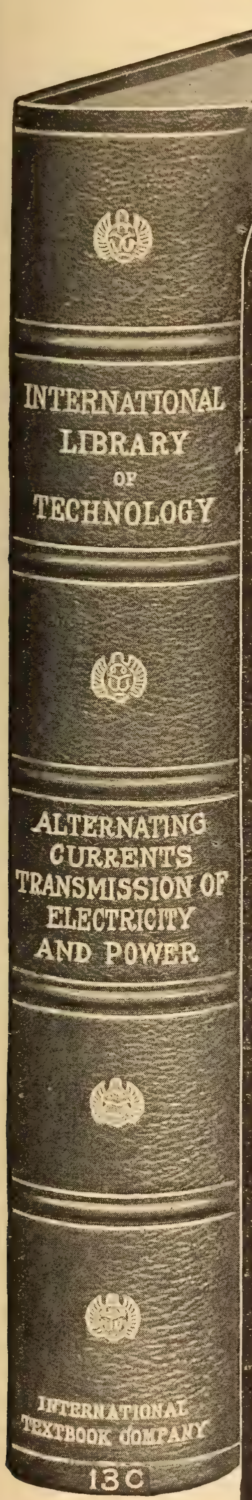

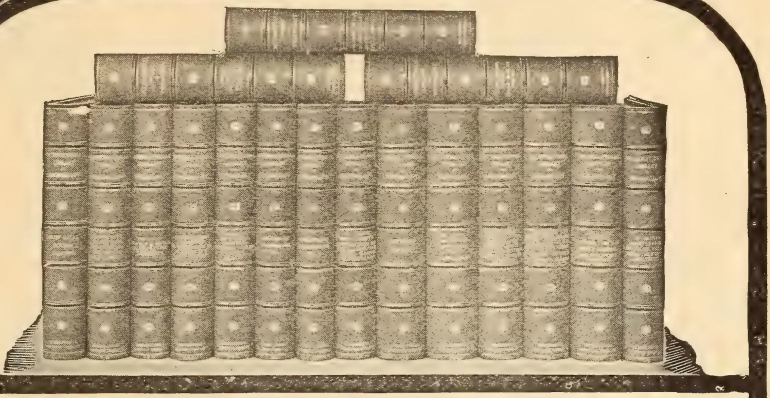

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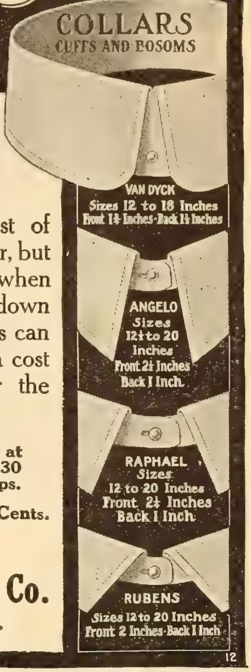

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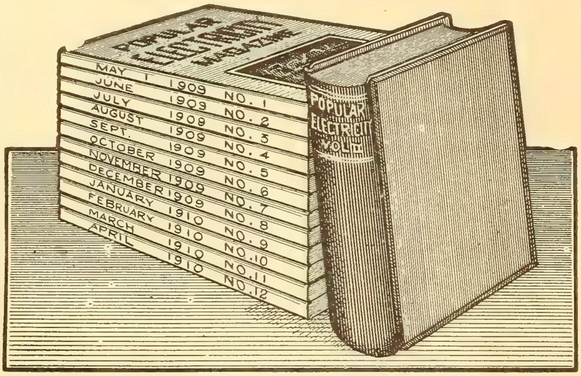

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Vol. III — March, 1911 — No. 11

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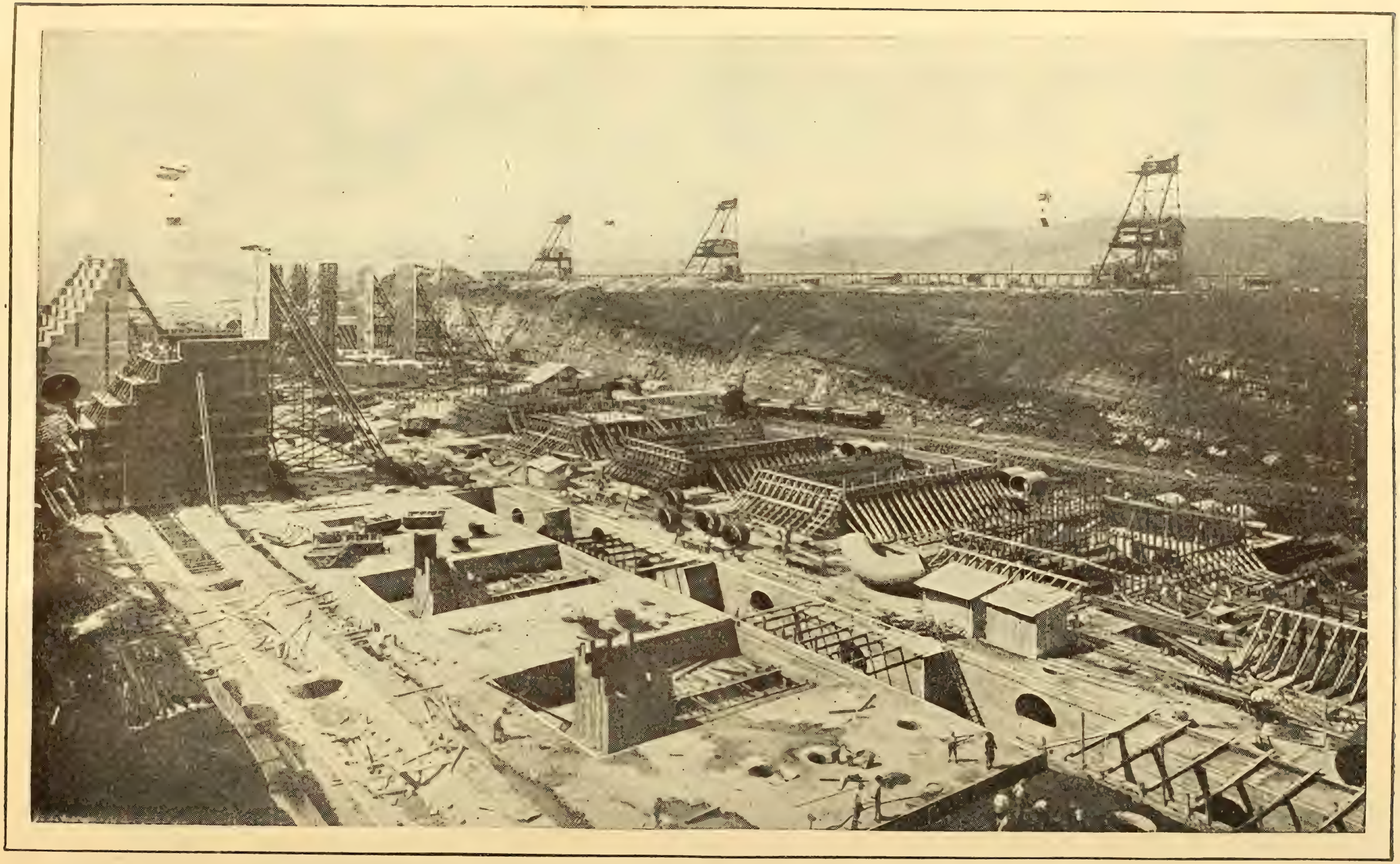

See page 956

FIG. 8. AERIAL BUCKETS CARRY THE CONCRETE TO ITS FINAL RESTING PLACE

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Popular Electricity
In Plain English

VOL. III MARCH 1911 No. 11

Electricity as a Builder of the Gatun Locks

By EDWARD SCHILDHAUER

Mr. Schildhauer, as Electrical and Mechanical Engineer of the Isthmian Canal Commission, is to be credited with the design and execution af those methods by which electricity has been permitted to enter so largely into the accomplishment of the stupendous task which American brains have now carried well within sight of completion. Mr. Schildhauer and Mr. Ernest Eugene Lee, Assistant Electrical and Mechanical Engineer, have jointly prepared a complete detailed account of the electrical and mechanical work thus far carried out, as a thesis for their Master Degrees in Mechanical Engineering from their Alma Maters, the University of Wisconsin and Iowa State College, respectively. Although the thesis contains a wealth of valuable engineering information, it is of course, too elaborate and technical to be published in its entirety in a popular magazine. Therefore, Mr. Schildhauer has kindly consented to give to the readers the following article, based on the thesis, but in Plain English.—Editorial Note.

One of the contributory causes for the triumph of the modern, American engineer over his less fortunate French brother in the digging of the Panama Canal has been the rapid advance made in engineering and construction methods since the days of DeLesseps. It is questionable whether, even with proper management, the French, with the machinery and methods then known could have pushed the work to completion. But methods have changed in recent years and not a few of these changes have been brought about by a knowledge of the applications of electricity.

Although electric current is used in every department of the huge undertaking in the Canal Zone, it is at the famous Gatun dam and locks that its aid is most important in carrying on the work. There new problems came up which never before and perhaps never will again demand the attention of engineers, and nowadays when original problems arise the engineer turns almost instinctively to its magic for the ways and means for delivering him from his dilemma.

A glance at Fig. 1 will show to the reader the relative locations of the immense dam, locks and spillway and the scale on the drawing will convey to the imagination somewhat of an idea of the size of the task in hand. The locks, spillway and a small part of the dam are of concrete construction and it was the economical gathering

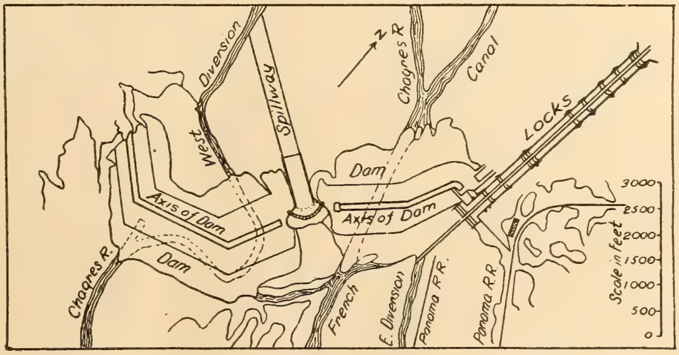


FIG. 1. SHOWING THE RELATIVE LOCATIONS OF THE GATUN DAM, LOCKS AND SPILLWAY

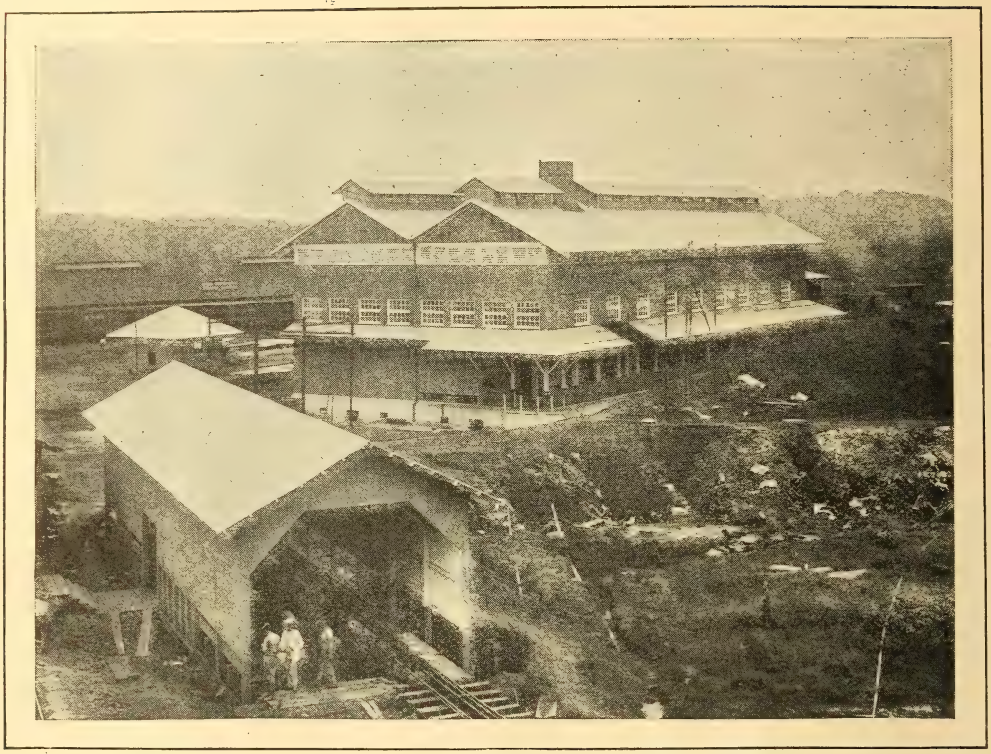


FIG. 2. ELECTRIC POWER HOUSE OF THE GATUN CONSTRUCTION PLANT

and mixing of the concrete materials and the final transportation of the concrete itself to the various parts of the work that taxed the ingenuity of all concerned, for it must be remembered that this is no ordinary job of concrete construction but involves the building of veritable mountains of artificial stone.

These things made necessary what is known as the Gatun Construction Plant, a vast industrial institution which will have been built, served its usefulness and been dismantled all in the short space of five years. Briefly, then, the object for which the Gatun construction plant was designed and built was primarily to unload, transport and mix the ingredients for concrete, and to place them, as used in the construction of the floors and walls of the lock chambers of the Gatun locks, and further, to transport the material used in the hydraulically filled portion of Gatun dam. The entire plant is essentially an electrically driven one, with the exception of the dredges and two auxiliary mixers. The system also includes the steam generating station and substation, which furnish, in addition to the current for lock and dam construction, current for various municipal purposes in the towns of Colon and Gatun.

In the design of the construction plant nine elements were to be considered: An electrical generating plant; rock and sand unloaders; cement cranes and cement storage; automatic electric railroad; concrete mixers; electric industrial railway; concrete depositing plant; lock wall forms, and the Gatun dredging plant. These separate elements will be taken up and their operation and relation to the other elements explained.

GENERATING STATION

Although it was to have a useful existence of only five years, the electric power plant was built with every modern feature and accessory including steam turbines. Fig. 2 is an exterior view of the commodious building in which it is housed. The building is the only thing about the plant suggesting its temporary character and is quite different in appearance from the substantial brick structures which we are in the habit of seeing in the temperate zone. The interior has every appearance of the modern power station, as shown in Fig. 3. Ranged along

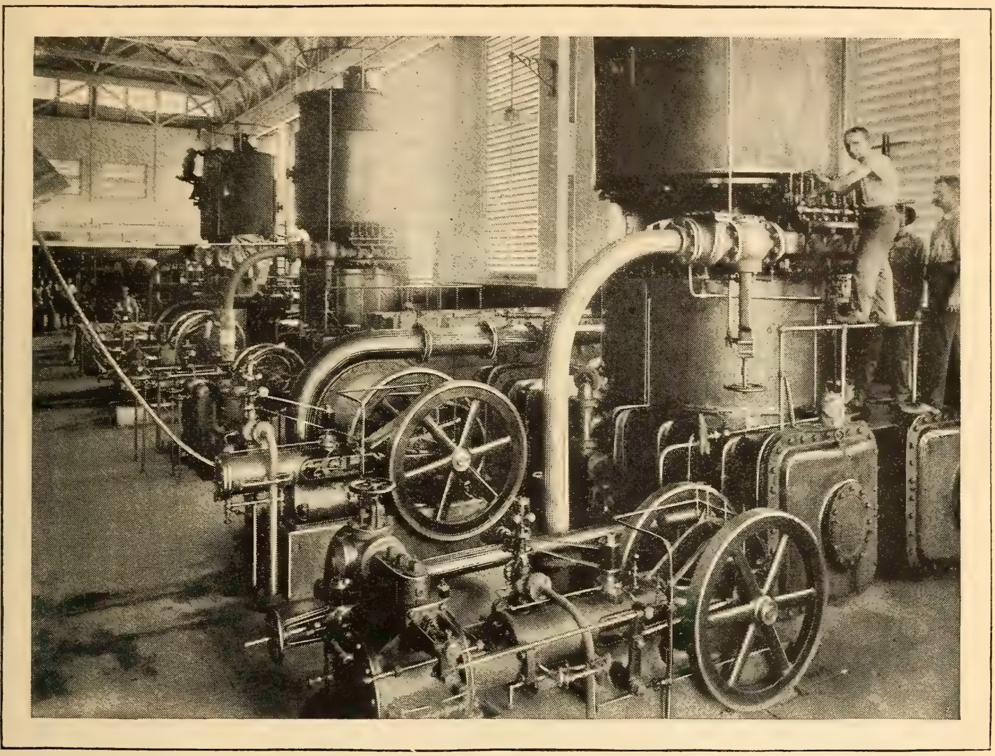


FIG. 3. THREE STEAM TURBINE GENERATORS IN THE GATUN PLANT, EACH CAPABLE OF DELIVERING 2,000 HORSEPOWER OF ELECTRICAL ENERGY

the side are the three vertical steam turbine generators of the Curtis type, each one capable of delivering 1,500 kilowatts or a little over 2,000 horsepower of electrical energy. An idea of the intricacy of the plant is obtained from Fig. 4, a view taken in April, 1909, before the concrete floor of the generator room was laid. All the maze of pipes, running in every direction, are electrical cable conduits through which the wires and cables leading to and from the generators and their auxiliary apparatus are drawn.

With this brief glimpse into the manner of generating the electrical current, let us pass on to some of its innumerable applications.

ROCK AND SAND UNLOADERS

The rock and sand which go into the making of the concrete for the giant monoliths which form the locks are brought to the site in barges. They enter a slip 600 feet from the great storage pile and then not a human hand is laid to the materials until they are in place as concrete. The slip, with its barges, and the storage pile are parallel with each other. On the side of the slip opposite the storage pile is a double track, two rails to each track. On the opposite side of the pile is a similar double track. On these tracks are operated traveling towers with two main cables stretched between each pair of towers, which, with auxiliary cables constitutes a duplex cableway. Great grab buckets, with a capacity of two cubic yards each, operate along these main cables. With precision a bucket drops down into a barge, seizes its mouthful of rock or sand and then up and away it goes across the cable to deposit its burden on the heap of stored materials which is almost a small mountain.

The equipment is entirely electrically driven. All the operating machinery is mounted in the head towers, under the vigilance of one attendant, but remotely controlled, the operator being stationed 800 feet away on the tail tower, so as to obtain a perfect view of the barge. Hoisting and traversing motions are obtained by independent auxiliary cables, each driven by an independent motor.

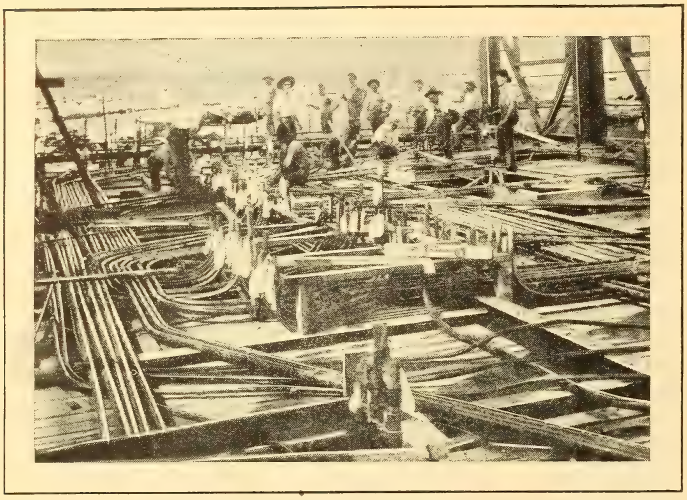


FIG. 4. SOME INTRICATE WORK IN CONSTRUCTING THE POWER PLANT—CONDUITS FOR WIRES AND CABLES

One strand of a duplex cableway is capable of unloading and transporting to the storage piles 60 yards of rock per hour, the traveling speed being 1,600 feet per minute. A single cableway is used for sand unloading and two duplex, for rocks.

That the plant may operate continuously, each main cable is illuminated at night by one eighteen-inch searchlight projector, installed on the tail tower.

The rock crushing plant is located 24 miles from Gatun at the old fort of Porto Bello, which may be remembered as one of the oldest Spanish-American forts, destroyed by Morgan, the buccaneer. During the months of November and December, severe storms occur on the Carribean, lasting from one to ten days, in which no rock barges can navigate. During this time the stock pile is appreciated, as this is the only source from which rock may be obtained to carry on the work.

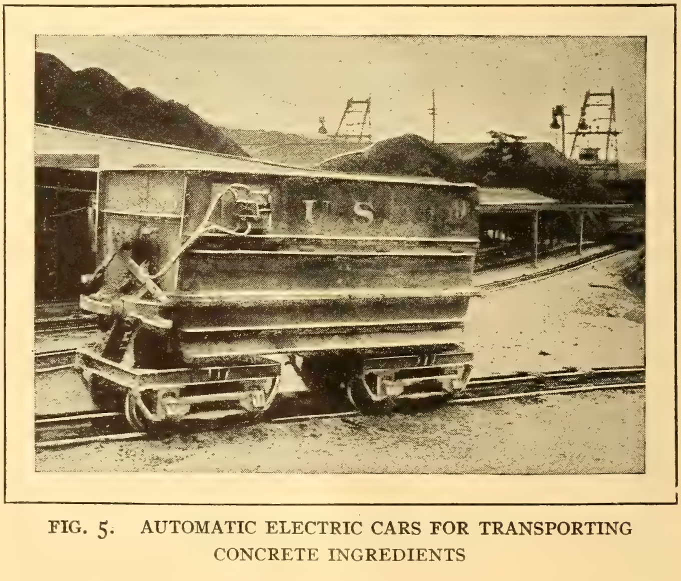


FIG. 5. AUTOMATIC ELECTRIC CARS FOR TRANSPORTING CONCRETE INGREDIENTS

CEMENT CRANES AND CEMENT STORAGE

The cement storage is on the side of the slip opposite the unloading tail towers. The building is a frame structure, divided into ten bays, each one of which is equipped with a crane having a span of 47 feet and a run of about 100 feet. The roof projects beyond the face of the dock to provide protection from rain, in unloading barges, and on these cantilever roof trusses the cranes run directly over the barge. The capacity of the cement storage is about 100,000 barrels.

On the main floor of the storage and on the side opposite to the unloading dock, there are 30 cement hoppers covered with stable steel screens into which the cement barrels or bags are emptied at the rate of 2,500 barrels per day. The charge of cement is measured by the barrel or bag in the hoppers, which have two-barrel capacity. The cement is drawn thence to cars passing under the hoppers. The empty barrels are taken by a conveyor running longitudinally with the building on the main floor and discharged a short distance from the building on a fire heap. To expedite the unloading of the cement steamers making delivery, the building is profusely illuminated, so that night work can proceed with almost as much celerity as by daylight.

We have now gathered the sand, rock and cement in their respective places of storage and all ready to be mixed into concrete for the lock walls. The next step is to convey these materials to the mixing plant and here again the recourse is had to electricity in the form of an automatic electric railroad.

AUTOMATIC ELECTRIC RAILROAD

The distance from the rock, sand and cement storage to the mixer building is over 2,000 feet, and the latter is 61 feet higher. The automatic electric road transports the concrete ingredients from storage to the mixer building. The road is automatic, inasmuch as the cars run without attendants. The cars are stopped, charged and started by the attendants at the respective storages.

In a similar manner the cars are emptied after arrival at the mixer building into charging hoppers above the mixers. The track from storage to mixers and return is a closed loop, and double-tracked excepting over the mixer charging hoppers and under the cement hoppers, where all cars run on a common track. The double-looped track mentioned passes under the stone and sand storage pile through tunnels. The tracks are separated considerably for sake of greater storage capacity. The cars travel in a counter-clockwise direction, receiving first cement, then sand and rock. In the event of a blockade on one track, cars can be operated over the other. One track only is required for full plant capacity.

Fig. 5 is a view of one of the automatic electric cars. It is of the side dump type, operated by two $7\frac{1}{2}$-horsepower motors taking current through two third-rails located in the middle between the track rails. It is a curious sight indeed to see these little cars travel along their narrow gauge track up and down grade without motorman or attendant of any kind. On the return trip they have a steep grade to descend and curious as it may seem to the layman they are made to do work while coming down empty.

On coming down this ten percent grade, as shown in Fig. 6, the wheels of the cars turn the motors instead of the motors turning

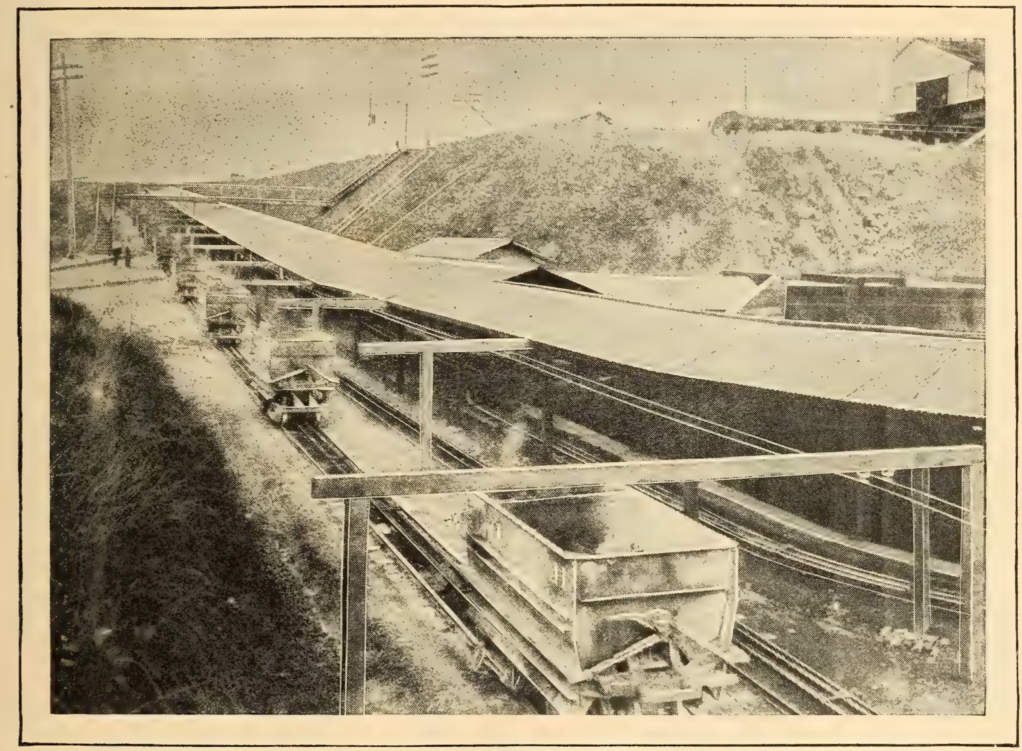


FIG. 6. AUTOMATIC CARS IN OPERATION—NO CHANCE FOR A MOTORMAN HERE

the wheels. The motors being rotated by external power then become dynamos (for a motor and a dynamo are practically the same thing) and pump current back into the line.

The speed at which the cars travel is about 300 feet per minute and ordinarily they operate at intervals of about 50 feet.

CONCRETE MIXING PLANT

The mixing plant consists of eight 64-cubic feet capacity cubical mixers as shown in Fig. 7. The mixers are driven in sets of two, from a jack-shaft. There are four jack-shafts, which are each directly coupled to a 75-horsepower motor, and the mixers are belt driven, having a tight and loose pulley.

The material from the hoppers above is admitted to the mixers by means of a segmental valve. This valve, together with the water supply valve and dumping lever are all controlled by the attendant on the mixer floor. The quantity of water supplied is automatically measured.

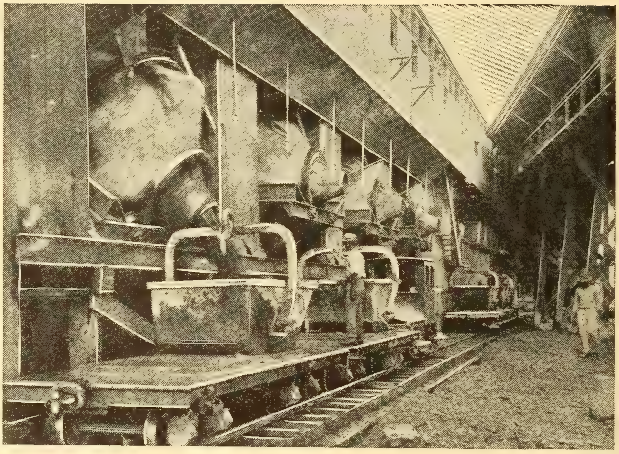


FIG. 7. THERE ARE EIGHT OF THESE CONCRETE MIXERS—64 CUBIC FEET CAPACITY EACH

The elevation of the mixers is such that the mixed material can be dumped into the buckets on the industrial railway flat cars, while on their normal track elevation. This industrial railway, a portion of which is seen in Fig. 7, makes the last long haul of the concrete to the site of its final resting place, the locks, where, for all we know, it may rest for centuries to come. The distance from the mixers to the lock cable ways may be as great as 2,000 feet in either direction, depending upon the stage of the work.

There are four tracks, each one of which will run to both ends. This amounts to a double track in each direction, and allows great freedom in the movement of trains. The general method is to run the trains in circuit. To insure minimum maintenance of road bed and minimum work about the third rail conductor, the roadway is ballasted with crushed rock from nine to twelve inches in thickness. The trains consist of two flat cars and an electric locomotive, each flat car outgoing having a full bucket of concrete and a place to receive the empty bucket with which it is to return. The car lengths have been so designed that a train may receive two batches of concrete from the mixers at one spotting, the center to center distance of mixers and main cables on towers being equal.

Arriving at the lock the buckets of concrete are ready to be lifted from the cars and dumped at the proper place in the concrete monolith which forms the wall of the lock. This is done by what is called the concrete depositing plant, the very last link in this chain of interesting events.

CONCRETE DEPOSITING PLANT

This plant is quite similar to the unloading cable ways at the storage yards. It consists of four duplex cable ways, that span the lock site. These spans are 800 feet in length or almost a sixth of a mile. In Fig. 8 (Frontispiece) you can see several of the buckets carrying the concrete to its last resting place and Fig. 9 is a near view as it is dropped into place. In this picture, also, is to be seen one of the immense structural steel forms, which stands vertically to the height of the wall and against which the concrete is packed.

In all, there will be a little over two million cubic yards placed in the forms for constructing the locks at Gatun. It is difficult to form a conception of the dimensions of such a mass, and a few comparisons may give some idea of the enormity of the undertaking. If the reader will imagine standing on the far side of the corner of State and Madison Streets, Chicago, surveying one block south to Monroe Street, one block west to Dearborn Street, and an equivalent vertical height, this will form, approximately, the three dimensions of a solid cube of this mass.

Another comparison is to lay a floor about four inches thick, extending over the area included by State Street and one mile west to Halsted Street, and from Madison Street six miles south to Garfield Boulevard. This mass of concrete will also lay an ordinary sidewalk, six feet wide, from New York to San Francisco and return to Chicago.

As to the dimensions of the concrete in the locks, in Fig. 10 is shown a side wall section with its main culvert and a lateral culvert located below the floor level with numerous holes entering the lock chamber through which the water will flow when filling and emptying the locks. To get an idea of the dimensions an ordinary six story office building is shown standing on the lock floor. A standard locomotive is shown in the main culvert and other features for comparison are added.

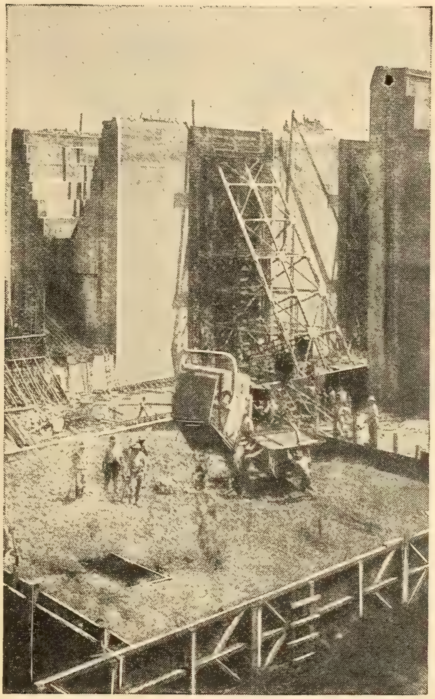


FIG. 9. DROPPING THE CONCRETE INTO PLACE

The final element in the problem of the construction plant as mentioned in the beginning, is involved in the Gatun dam dredging plant. But as this work does not embody features of unusual interest, it will not be taken up in detail.

Now what is all this concrete work for? Why those gigantic walls? The answer is simple, for they embody the same principle as that in canal locks since remote times.

The locks, however, are very much larger than any ever built. The locks at Gatun may be compared to a stairway of three steps with provision for gates to hold the water at predetermined levels so that the ship is lowered in three successive steps from the lake level, 85 feet above the ocean, to the level of the canal leading to the ocean. This process is reversed for ships going in the other direction. To pass a ship from the lake to the ocean level the upper lock is filled with water even with the lake level. The ship is hauled into the lock by powerful electric locomotives. The upper gate is closed and a large valve in the side culvert is opened to pass the water from the upper lock to the middle lock. This flow continues until the levels in the two locks are the same so that the ship is at a lower level in the upper lock. The lower gate of the upper lock is opened and the electric locomotives haul the ship to the middle lock. The operations are repeated until the ship is in the canal leading to the ocean.

It is, however, in the magnitude of the work and the special devices for the operation of the gates, valves, etc., that the Gatun locks are different and more wonderful than anything in that line hitherto undertaken.

In conclusion just a word may be said concerning the gates and their operation, which constitute a unique feature. The gates may be compared to huge doors, swinging on hinges and meeting at an angle in the center of the lock chamber. The largest gate is 65 feet long, seven feet six inches thick and 84 feet high. For comparison, the reader may stand on the seventh floor of an ordinary office building, located on a street which is 110 feet between the building lines and imagine the buildings to be the lock walls. Then suppose that this street

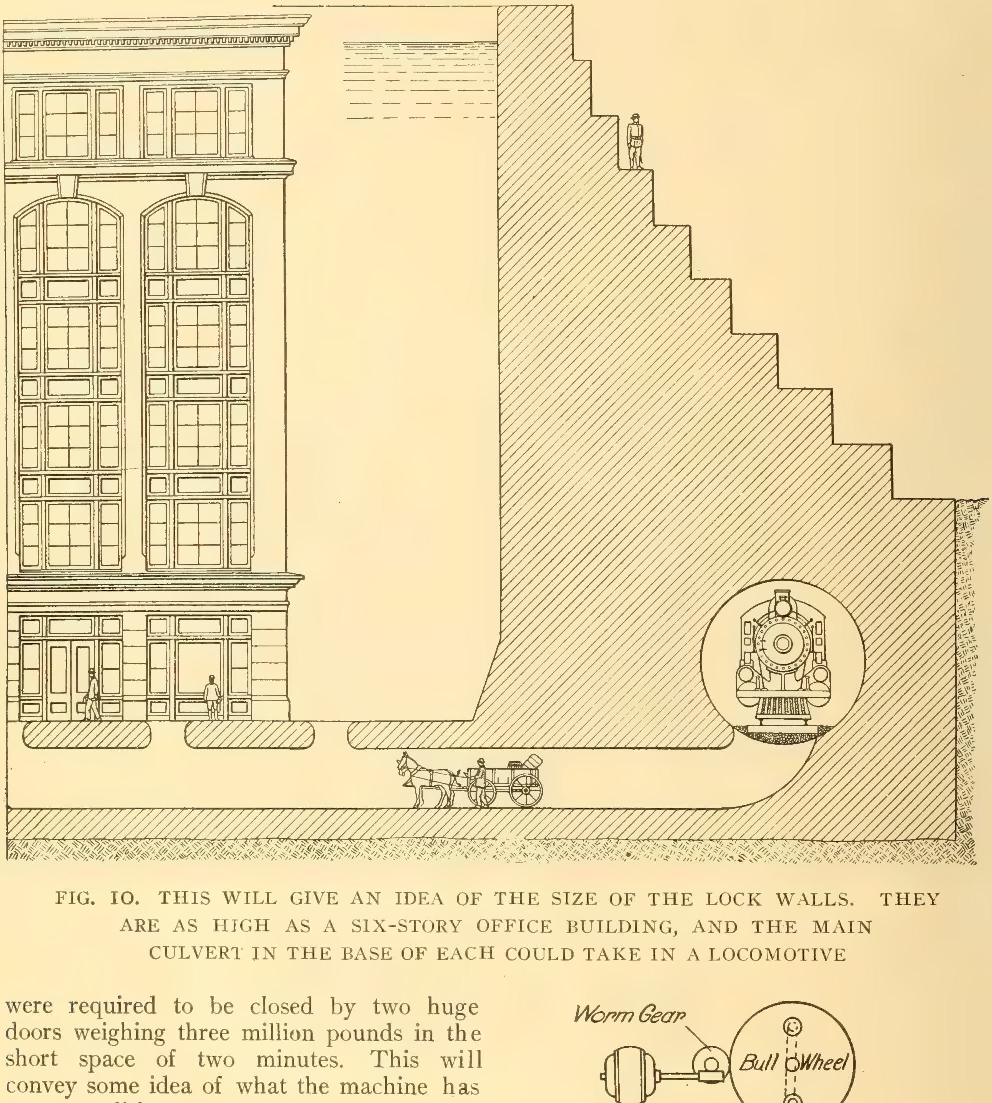


FIG. 10. THIS WILL GIVE AN IDEA OF THE SIZE OF THE LOCK WALLS. THEY ARE AS HIGH AS A SIX-STORY OFFICE BUILDING, AND THE MAIN CULVERT IN THE BASE OF EACH COULD TAKE IN A LOCOMOTIVE

were required to be closed by two huge doors weighing three million pounds in the short space of two minutes. This will convey some idea of what the machine has to accomplish.

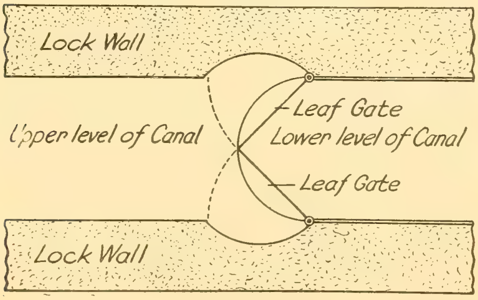


FIG. 11. PLAN VIEW, SHOWING THE PRINCIPLE OF THE LOCK GATES

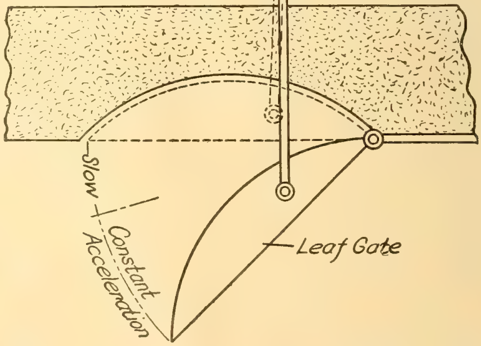


FIG. 12. METHOD OF OPERATING THE GATES

Fig. 11 is a plan view showing the principle. Normally the gates stand as shown. When water from the upper level is let out into the lower level through the culverts and a ship is passed through the locks, the two leaves are drawn back into the recesses in the side walls. This requires considerable power and is accomplished as shown in Fig. 12. A horizontal "bull" wheel is mounted as shown and revolved by an electric motor. An arm from this wheel operates one leaf of the gate. Suppose the gate is to be opened. The motor is started up and revolves the bull wheel at a constant rate. The motion of the gate is slow at first because the connecting arm is almost on a "dead center." This is as it should be for the power required to operate the gate is large when it first starts to open, and consequently the motion should be slow. As the connecting arm gets off from the dead center the speed of the gate accelerates until the pivoted arm gets around toward the opposite side of the path of travel when the speed of the gate begins to decrease. This is also a decided advantage for, as the gate begins to close into the recess in the wall, the impounded water must be given time to escape gradually or else enormous power would be required. If it were not for this ingenious arrangement, a complicated variable speed motor arrangement would be necessary at heavy cost and would not give as satisfactory results. The motors for operating the gates at each system of locks are controlled by one man from a single switch house. Here the operator sits with a little miniature lock and gates in front of him and by the simple movement of a few switches controls the movements of the great leaf gates and the other apparatus in the real lock without ever seeing them, fixing his attention entirely on the model which moves in unison.

Electricity in the Modern Theater

"We could not run this house without electricity," declared the manager of a large new theater recently. "I can scarcely enumerate the many ways in which we use electricity and we can only wonder how we ever got along without it." Not only is electricity used for the general illumination of the theater, but it is relied upon for stage effects of lighting, flame and fire, storm and crash, warmth and benignity, that are sometimes, with their easy or rapid gradations, fairly marvelous. The mechanism of many important "acts" and illusions are entirely electrical; the call-boy has been superseded by electrical signals from stage manager to dressing rooms, and heating and ventilation are controlled by electrical means. Even the scrubwomen are provided with baseboard attachments so that they can secure sufficient illumination."—*Electrical World.*

Aerial Searchlights

Among the most serious problems of modern naval warfare is that of lighting the enemy's vessels sufficiently at night to make them good targets. If this is done by the ship's own searchlights, the beams from the same will locate the ship carrying them, thus exposing it in turn to the enemy's shot and shell. The really desirable solution would be one that left the enemy entirely in the dark as to the location of his opponent until the devastating shots rained down upon him. For this purpose it has been suggested that the active searchlights be mounted on smaller vessels (such as torpedo boats) which would be harder to hit and not so costly to replace if sunk, but as soon as such smaller boats go some distance from the man-of-war it is difficult to communicate with them without using either lamp signals or wireless messages which may immediately be observed.

A novel substitute for this plan has just been patented in Germany by L. J. Mayer of Metz, the warlike frontier town which Germany wrested from France in 1871. Meyer proposes to mount a powerful electric searchlight in the basket of a captive balloon (see front cover) sent up from the man-of-war. Current would be supplied to the lamp through wires forming part of the cable which holds the balloon in check, while additional wires would operate magnets to rotate the searchlight. The current would not be turned on until the balloon was high in the air, hence its presence would not be suspected until the telltale beam flashes across the high sea and as the wind will usually have carried the balloon far from its master ship, the enemy could not readily judge the location of the latter. At the same time, the lamp basket itself would be too small an object to hit without an enormous waste of shots and by dropping it some distance below the gas bag the exact location of the latter would also be mere guesswork.

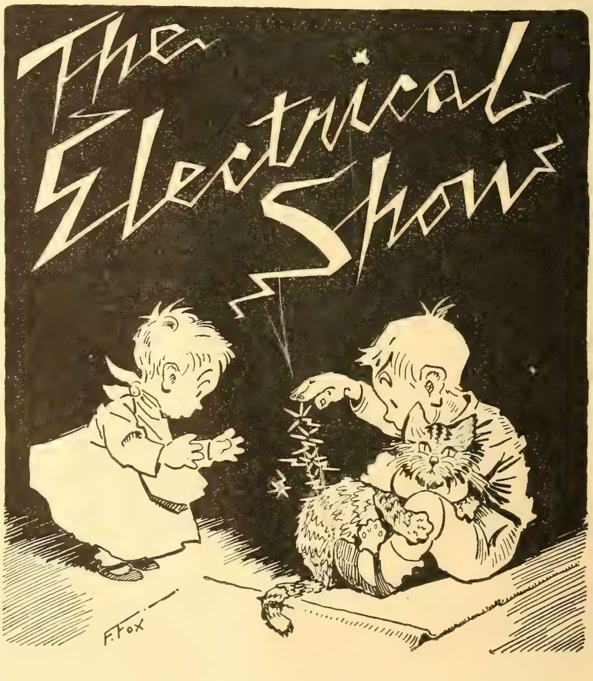
The Chicago Electrical Show

"What won't they do next!" seemed to be the opinion of the thousands that elbowed their way good-naturedly through the Chicago Coliseum during the great Electrical Show. "My but that is some heat" someone would announce confidentially to his neighbor as they stood blinking into the depths of a white hot electric furnace and trying to imagine how long a finger would last if it were stuck into a region of 3,000 degrees Fahrenheit.

"Well, what do you know about that!" was an expression you could hear from almost anyone who had striven and stretched sufficiently to bring into the line of his vision the source of a mysterious rattling and thumping—a giant electromagnet toying with a few hundred pounds of pig iron.

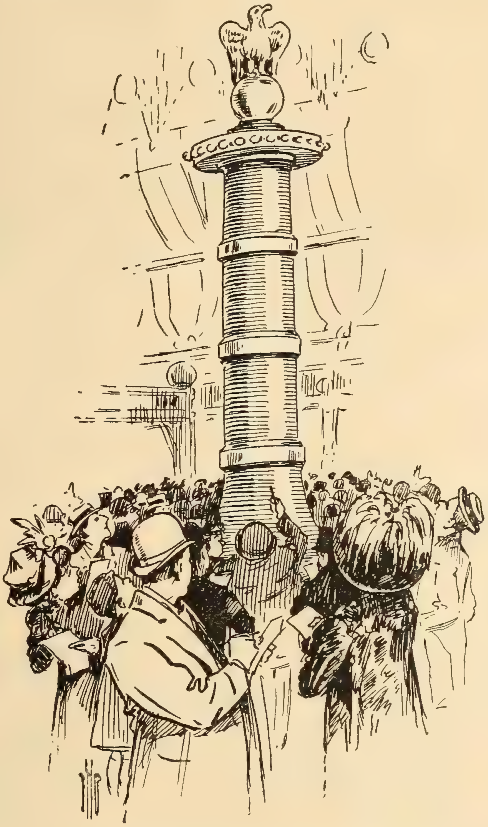
"I just talked to a fellow in New York, and he had the sweetest voice," giggled a High School miss to her companions as she emerged from a telephone booth where visitors were permitted to step up and hear what the human voice sounds like when coming from a thousand miles away.

"I don't care for it. Doesn't taste right, and I know it wouldn't quench the thirst in hot weather," scornfully remarked the gentleman from Milwaukee as he blew across a glass of ozonated water and let it slide neatly down his throat without the least gurgle or confusion. "It ain't got any hops in it," he concluded as he involuntarily wiped a line of imaginary foam from



IMPRESSIONS OF THE ELECTRICAL SHOW AS DEPICTED BY CARTOONIST FOX OF THE CHICAGO EVENING POST his lips. "You are right friend," replied the demonstrator. "There are no hops, toads, microbes or other animals in this water once it is impregnated by our improved electrical process, with that wonderful and mysterious allotropic form of oxygen known as ozone." "Comes from the tropics does it? Huh! Schlitz is good enough for me," and Milwaukee hurries on to inspect nine orphaned eggs slowly hatching in an electric incubator.

In the center of the great hall stood a pillar three times as high as a man's head and composed of a number of drums wound over their entire surface with copper wire. These drums were diabolically conceived and executed so as to embody every mathematical curve and surface dealt with by mathematicians since the days of Copernicus; including truncated cones, parabolas, circles and a few other things. Given the height of the various drums, the size of the wire and a diameter or two, the problem was to guess the total number of feet of wire so as to win an electric automobile. Some who "never were good at figgers" preferred to make a blind stab at it, one optimistic young lady thinking that seven million feet would be about right. She is doubtless doing her shopping on foot.



SET THEMSELVES SQUARELY IN THE CENTERS OF TRAFFIC

Others of a mathematical turn of mind set themselves squarely in the centers of traffic around the pillar and figured from an hour to an hour and a half each. Their expressions were stonelike. These last, when they had arrived at and handed in their answers immediately passed down the line and clambered into electric autos on exhibit and proceeded to familiarize themselves with the steering gear, batteries etc., so as to be all ready for business when the final result of the contest should be made known.

Finally came some United States government inspectors and figured upon the problem. Their minds becoming confused by its complexity, and having automobiles at home anyhow, they arrived at the conclusion that the whole thing was a lottery, that it was pure guess-work, that there is no such thing as mathematics in the world—away with it!

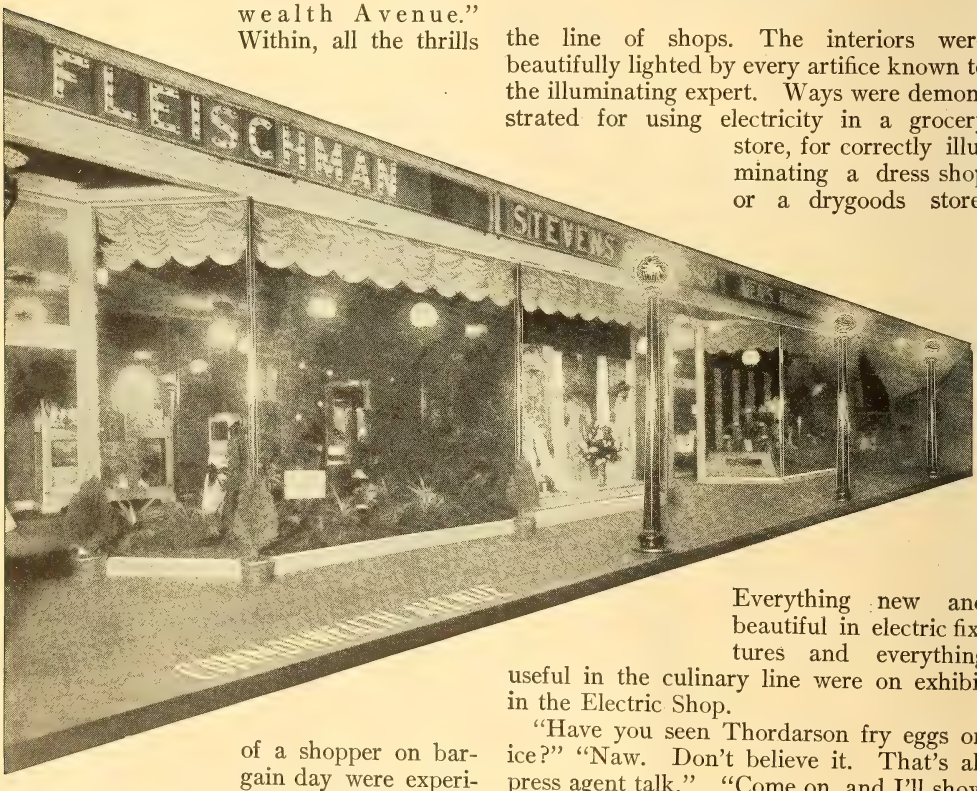
Over in one corner was the exhibit of the Artcraft Institute at which educational work was going on, extending throughout the whole realm of electric cookery. Here was a long table, an electric kitchen cabinet and an electric washing machine to lend variety to the scenery. On the table were electric utensils of all the well known makes. Under the edge of the table were outlets from an electric circuit, for plugging on the various devices. On the floor and in the corners was food in the raw. The stage was set. Arrive, now, on the scene a group of club women to learn of electricity and spread the propaganda. They file behind the table, take up cords and plugs and at a signal the "work" begins. We quote the word "work" however, for cooking with electricity as everyone knows is play and it is believed by electrical authorities that the word "work" as now applied to household activities will in the near future become obsolete.

Never was a class more interested. There were several types of outlets under the table and several styles of plugs on the cooking devices. This caused a little confusion at first. It was found out incidentally that an an egg absolutely refused to fry on a General Electric stove if a Westinghouse plug was used. Likewise a Westinghouse percolator refused to have anything to do with current through a Simplex plug. These little family differences being attended to the cooking progressed.

All this interested the throngs, particularly some fortunate men who were selected at random, or for other reasons, to come in and act as eaters.

At the corner of one of the booths anywhere from six to twenty people might be observed at any time sniffing ozone. They all took very deep breaths and then looked sadly, far away into the distance, trying to imagine "mountain air." The little machine which caused all this reminiscing was no more than eighteen inches high but it sent out a blast of air heavily impregnated with the somewhat pungent odor of this strange gas which is formed in the region of a high potential electric discharge.

SNIFFING OZONE



One end of the hall was taken up with a row of miniature shops and stores all facing out onto "Commonwealth Avenue." Within, all the thrills of a shopper on bargain day were experienced. A member of that sex which most delights in this form of battle would approach the entrance with fire in the eye and at once plunge in absolutely without fear. Once inside, it was action every minute of the time, all the way down through the line of shops. The interiors were beautifully lighted by every artifice known to the illuminating expert. Ways were demonstrated for using electricity in a grocery store, for correctly illuminating a dress shop or a drygoods store. Everything new and beautiful in electric fixtures and everything useful in the culinary line were on exhibit in the Electric Shop.

"Have you seen Thordarson fry eggs on ice?" "Naw. Don't believe it. That's all press agent talk." "Come on, and I'll show you," says the electrical engineer to his friend the bank cashier. They push their way through to the annex. The cashier wants to

INTERIOR OF THE COLISEUM DURING THE CHICAGO ELECTRICAL SHOW, JANUARY 7-21

stop and listen to the amateur wireless fiends who are seated with ecstatic expressions, and wreathed in the flames of their resounding instruments, but his friend drags him away to the corner wherein is the Thordarson "Wireless kitchen." They line up beside the rail and watch the show. Thordarson, the "electrical wizard," presides behind a sort of long counter. At his left is the usual "assistant" who from time to time makes a mysterious pass under the table as if to scratch his ankle. This is not supposed to be noticed by the crowd.

"Here we have the wireless churn," says the wizard. This imposing apparatus consists of a sort of glass stein without a handle and half full of water. In the water is a metal sphere with a wire or two around it. Setting the whole thing on the top of the table the sphere revolves rapidly until set to one side when it stops as if tired.

"Wireless lamp" shouts the wizard. This time he takes up a circular coil of wire wound on the outside with tape and with an incandescent lamp connected to the center; no connections whatever to any external source. Holding the lamp over the table it burns brightly.

"Now we will fry an egg on ice," explains the wizard. He places a frying pan on the table top and turns away for an instant. The assistant scratches his ankle and the pan aviates away ten feet.

Having secured the pan again the wizard passes down the line and lets the cashier and the electrical engineer and the rest of the crowd feel of it and of a slab of ice which he has in his hand. Both cold. Then he goes back and places the ice on the table. Then he holds the pan over the ice for a few moments. The second assistant wizard carefully selects a bunch of lard and puts it in the pan. It sizzles slightly. Second assistant then awkwardly breaks an egg in the pan. It sizzles, fries and actually smells good. All this time the pan sets on a slab of ice.

"I'll be jiggered if that doesn't get me," says the cashier. "Now tell me how he does it—you, who think you know electricity."

Says the electrical engineer, "It is done, not by what we ordinarily call wireless current; that is, high voltage, high frequency current

"NOW WE WILL FRY AN EGG ON ICE," EXPLAINS THE WIZARD

which transmits wireless messages, but by the ordinary low voltage alternating and direct current which is used for lighting. Under that table are large transformers the cores of which form immense electro-magnets. When that assistant juggles under the table he closes a switch which sends current through the transformers. As a result the table and the wizard himself are plunged into a powerful magnetic field, which of course is not harmful to them. This field may be made alternating by sending alternating current through the transformers, in which case it rises up and dies down many times a second. Now when you place the frying pan in this field of magnetism the metal in it may be considered as a closed circuit and the fluctuating magnetic field causes electric currents to flow in the metal of the pan, though non-metallic objects such as ice, the table top, etc., are not affected. These eddy currents as they are called (and they are developed in any solid piece of iron placed in an alternating magnetic field) quickly develop heat enough to fry the egg.

"In the same way the lamp is lighted. The coil of wire in this case is affected by the magnetism and has generated in it sufficient current to light the lamp.

"When the frying pan was made to jump off the table only direct current was used in the transformer. When the switch was closed there was a great outward surge of magnetism as the field was established around the transformer and the metallic pan was repelled by this field and whisked away."

"Oh! I see," said the cashier as they wended their way to the door to catch a Wabash Avenue car, casting one more look backward at the wire column where several men were still earnestly figuring.

The Coming of the Multiplex Telephone

By WILLIAM C. WARD

What bids fair to be a great advance in the telephonic art was inaugurated when Major Squier, on January 3rd of this year, gave to the people of the United States his patents on a system of multiplex telephony; that is, a system it is claimed, permitting of sending several non-interfering messages over one circuit at the same time. As has happened so many times in the past, in the case of great inventions, two men apparently were working on the same idea about the same time. Mr. Frank L. Perry of Chicago, widely known in electrical circles throughout the country, demonstrated over two years ago, to reliable witnesses, that a non-interfering voice message could be transmitted over an isolated circuit which was at the same time being employed for transmitting a to and fro conversation. It is only fair, therefore, that, following Mr. Ward's description of the Squier system, we give an account of Mr. Perry's work and the excellent proof which he has to offer establishing the fact of his independent research.—Editorial Note.

The utilization of combined wire and wireless practice, patents for which have been taken out and dedicated to the public by Major George Owen Squier, United States Army, amounts to what will prove to be the greatest stride made in electrical communication since the invention of the telephone itself. In the new system, multiplex telephony—heretofore never practical—is easily accomplished; also, any number of telephone and telegraph messages may be sent simultaneously over the same wire without any mutual interference, and one of the most important features of the invention is the absolute elimination of the distance restriction which until now has prevented further developments in long-distance telephony.

Ever since the electromagnetic theory of light became an accepted fact, the whole range of ether waves has been looked upon as a spectrum extending from the extreme ultra-violet rays on the one hand, through the visible spectrum to the exceedingly slow oscillations that are used on submarine cables. Also use has been made of all parts, for various purposes, with the exception of two well-defined intervals; one extending

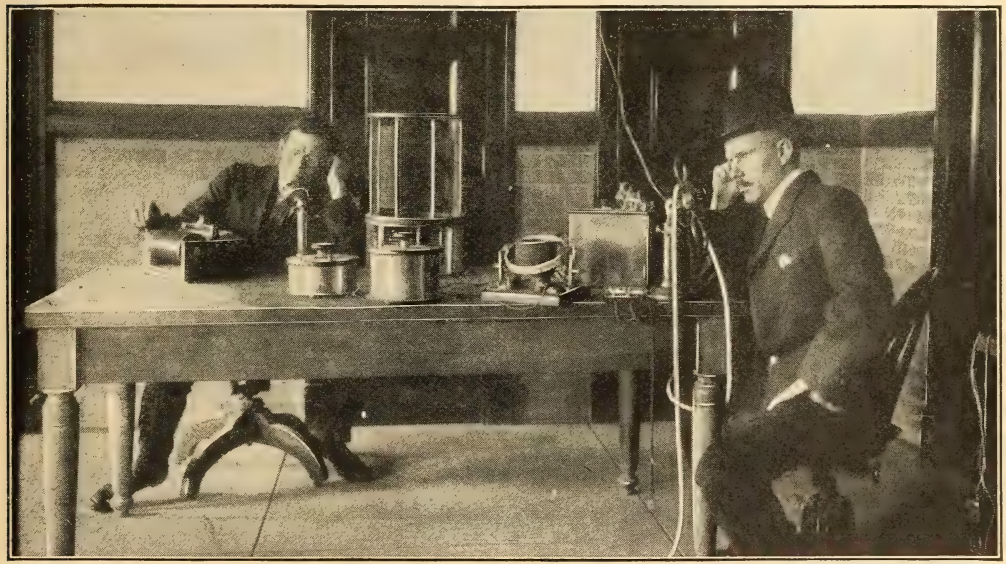


Photo by Waldon Fawcett

MAJOR SQUIER OF THE UNITED STATES ARMY, AT THE RIGHT, AND HIS ASSISTANT TALKING SIMULTANEOUSLY OVER ONE LINE WITHOUT INTERFERENCE

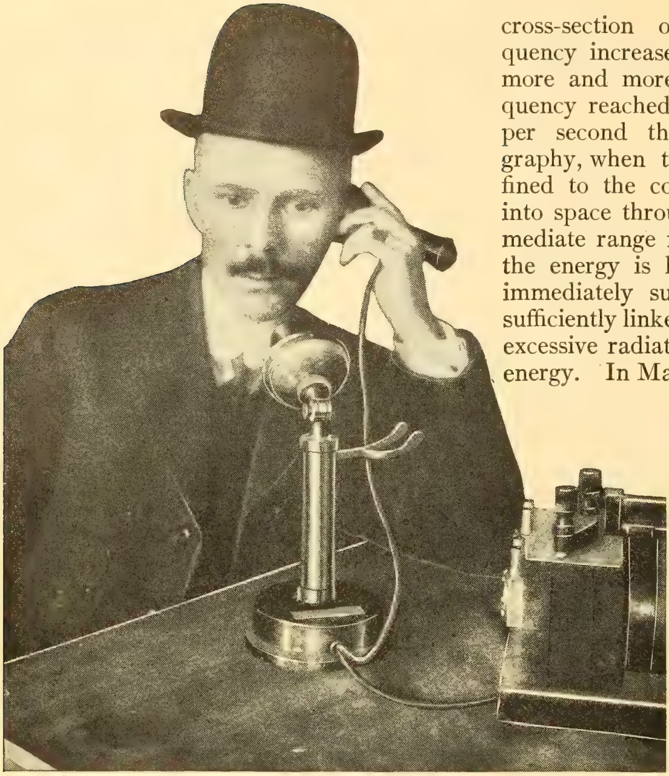


Photo by Waldon Fawcett

MAJOR SQUIER USING HIS FIRST MULTIPLEX TELEPHONE

from a frequency of about 3 x 10^{12} of the extreme infra-red, to 5 x 10^{10}, which is the shortest wave yet produced by electrical apparatus—and another interval extending from 100,000 cycles per second to 15,000 cycles per second. This latter represents a practically unexplored field which Major Squier has found by experiment to be very useful in solving the problems of multiplex telephony and telegraphy.

With such frequencies as are used in ordinary battery telephony the so-called phenomenon of "skin effect;" that is, the tendency of the electric current to flow on the surface of the wire, is comparatively small, and the current fairly well distributed throughout the cross-section of the wire. As the frequency increases, the skin effect becomes more and more pronounced until the frequency reached the realm of the millions per second that are used in radio-telegraphy, when the energy is no longer confined to the conducting wire, but radiates into space through the ether. In the intermediate range from say 20,000 to 100,000, the energy is largely carried by the ether immediately surrounding the wire, but is sufficiently linked to the conductor to prevent excessive radiation and the resultant loss of energy. In Major Squier's system, then, the loss of power due to the ohmic resistance of the conductor is eliminated by employing currents of sufficiently high frequency to be carried in the ether surrounding the wire rather than in the wire itself, and as a natural result more work can be performed at a great distance than can possibly be expected of a low-frequency conduction current.

Oscillatory currents of the frequency employed are, however, much too rapid in their periodic reversals to produce audible effects in a telephone receiver. The limits of sensitiveness of the human ear lie between frequencies of from 16

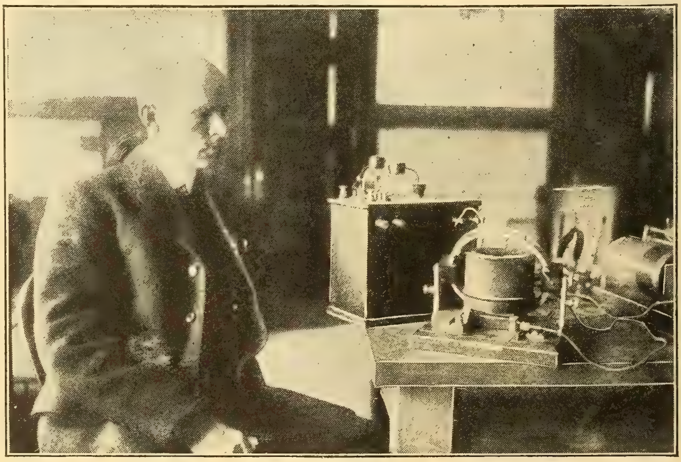


Photo by Waldon Fawcett

PRINCIPAL PARTS OF THE SQUIER MULTIPLEX TELEPHONE SYSTEM to 20,000 cycles per second, and entirely apart from this is the fact that it is a physical impossibility for a telephone receiver diaphragm to vibrate in syntony with any oscillations of much higher frequency than the maximum limit of audibility. For this reason Major Squier has found it necessary to employ a detector such as that now used in wireless practice to integrate the oscillations into one-dimensioned effects that will cause telephone receivers to respond audibly, as they now do in ordinary battery telephone systems.

Both the sending and receiving stations are therefore connected inductively with the line wires, and a generator at the sending end is kept giving out undamped oscillations upon which voice vibrations are impressed by a microphone transmitter in the primary circuit as is now the case in the ordinary wireless telephone. At the receiving end, an inductively connected circuit with an integrating detector shunted across the telephone wires, exactly as in wireless practice, translates the messages into articulate speech. It is obvious that the number of messages that may be simultaneously transmitted over the same line wire is limited only by the number of frequencies to which oscillating circuits may be tuned, and this borders on infinity. Also it is evident that telegraph and telephone messages may be sent over the same wire at the same time, so long as the frequencies of the different sustained oscillations of which their signals are modifications are not sufficiently near together to cause interference.

One of the most important economic features of the invention is the elimination of the necessity for using a return wire in telephone circuits. This has heretofore been necessary on account of interference from earth disturbances, cross-talk from other circuits, electric railway complications and many annoyances from unknown sources. All of these outside influences, however, are of low frequency, and their elimination from the Squier system is due to the use of condensers of very small electrical dimensions, which, though imposing great impedance to slow oscillations, offer little or none to frequencies as high as 100,000 cycles per second.

Though the Duddell arc and other approved sources of sustained oscillations have been successfully used, Major Squier relies chiefly upon a generator of his own design to supply the necessary oscillations direct. This machine, which is the power behind the throne in the new system, consists of the usual coils between which rotates an armature about one foot in diameter at a speed of 20,000 revolutions per minute. The generator gives out approximately pure sine waves corresponding to a wave-length of 1.86 miles.

In this system practically all of the generated energy is used, while in wireless telegraphy nearly all of it is wasted as the diameter of the radiated wave-sphere expands—that is the surface density of the sphere, which is expressed in terms of energy, decreases as an involved function of the radius increases.

It will be remembered that no practical use was ever made of wireless telegraphy until Marconi grounded one wire and sent out earth-guided waves. Hertz, too, noticed the performance of waves traveling along conductors. But it has remained for Major Squier to make use of wire-guided oscillations and to develop the first practical universal multiplex system.

For many years Frank L. Perry of Chicago had in his mind the idea of duplex telephony. At first it was only an idea and a vague one at that, evolved from numberless experiments in the mystifying field of vibratory electrical energy. He spent every hour of spare time at his researches in electrical wave phenomena.

Gradually the idea took form and in 1908 he was able, with crude apparatus, to do a wonderful thing in his home laboratory at 3702 Lake Avenue, Chicago. Two people talked back and forth over an isolated metallic circuit and also over an isolated grounded telephone line, using ordinary transmitters operating in connection with the ordinary receivers, and at the same time Mr. Perry with his new duplex transmitter, connected to this same line transmitted phonographic "talk" to a witness in another room; and the witness heard it, but did not hear the other two people who were conversing without interference over the line at the same time.

Then for absolute proof the witness was given the ordinary receiver connected to this same isolated single line. He held it to one ear and heard a person talk over the line with ordinary instruments. Drawing it away he held the special receiver to the other ear and

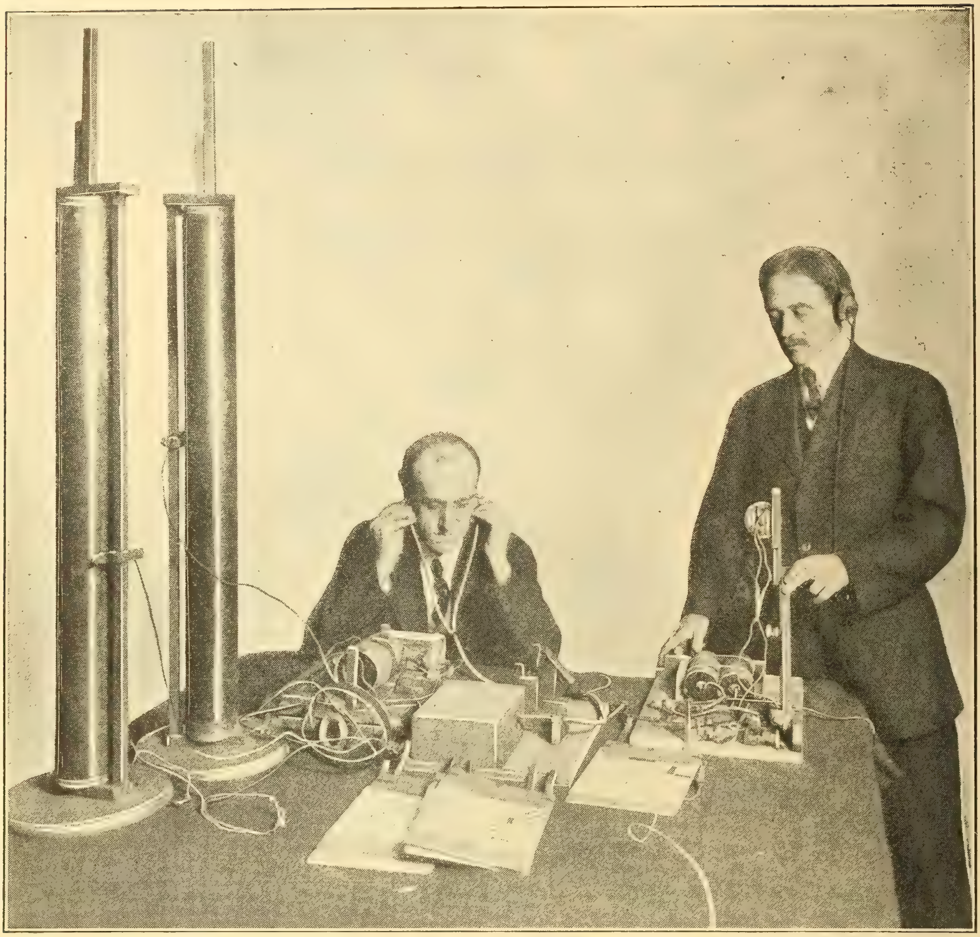


Photo by Burke & Atwell

READY FOR THE TEST—CRUDE TELEPHONE OUTFIT OF THE ORDINARY TYPE AT THE RIGHT, FOR "TO AND FRO" MESSAGES; TWO PERRY DUPLEXING RECEIVING SETS AT THE LEFT

heard only the phonographic talk with musical accompaniment. Bringing the two receivers to his two ears he heard the confusion of the two transmissions and knew beyond a doubt that the one circuit was carrying at the same time two sets of voice messages, either of which he could listen to independently, depending on which receiver he used. Duplex telephony had "arrived."

The witness on this occasion, November 4, 1908, was Mr. Bion J. Arnold, the celebrated consulting engineer and traction expert. He gave to Mr. Perry signed statements and signed a drawing verifying this important achievement.

Supplementing Mr. Arnold's testimony a signed statement was procured, after similar demonstration, from Mr. Donald M. Carter of the law firm of Parker & Carter, Chicago.

Still other men were permitted to listen to the performances of this Perry duplex telephone system, namely: Mr. B. E. Sunny, president of the Chicago Telephone Company and vice president of the American Telephone and Telegraph Company, heard a successful demonstration in October, 1909; Francis W. Parker, of the firm of Parker and Carter, and Dr. C. F. Barker, a well-known Chicago physician and surgeon, all witnessed successful tests.

Mr. Perry wisely is not telling any one just how he does it. But immediately after announcement of Major Squier's achievement came from Washington, he quickly repeated before Mr. Rufus Hatch Holbrook, associate editor of *Telephony*, his successful accomplishment. The system is essentially the same as that employed over two years ago when Mr.

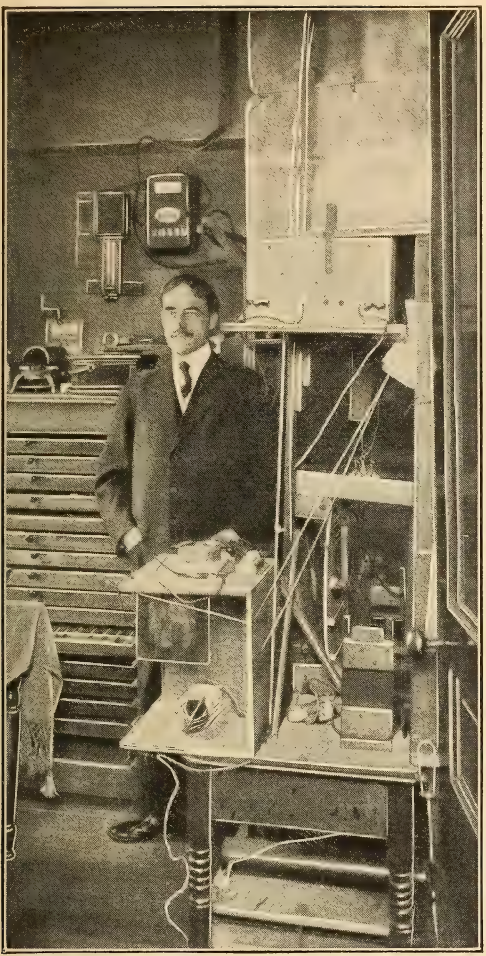


Photo by Burke & Atwell

MR. PERRY IN HIS DUPLEXING "SENDING STATION"

Perry first put the second telephonic message (voice) on the one isolated circuit that was at the same moment being used to convey back and forth the electric waves of ordinary "to and fro" telephonic conversation.

This new and additional voice message was at that time sent in only one direction, that is, to a listener. But be it understood that this transmission of a second and additional telephonic message in one direction over the one circuit was enough, Mr. Perry knew, to demonstrate before creditable witnesses the discovery of duplex telephony.

With reference to the illustrations presented herewith, Mr. Perry frankly states that there are of course certain parts of the apparatus boxed up and purposely otherwise concealed; but in so far as any ordinary visiting observer could see, the photographs herewith give a most excellent idea of the general appearance of the apparatus as it was used over two years ago, and as it was employed within a day or so after the announcement from Washington, this year.

On almost every occasion in demonstrating, he places two people at the two receiving stations in one room. With one of these persons at one of these receiving stations, a second person in another room converses. In a word, an ordinary "to and fro" telephonic conversation is carried on between these two people over a single isolated metallic circuit or an isolated single wire grounded circuit. This circuit in some cases covered a distance over surrounding roofs of a little less than a city block.

While this ordinary "to and fro" telephonic conversation is being carried on between the two persons, one at each end of the above mentioned single circuit, it has been Mr. Perry's general custom to send over this same one circuit in one direction to the other person in the receiving room, either another human voice or a phonographic reproduction of the human voice (with song and musical accompaniment.) This second human, or phonographic-human voice and music, is

Photo by Burke & Atwell

CRUDE TELEPHONE OUTFIT OF THE ORDINARY TYPE AS USED FOR "TO AND FRO" MESSAGES delivered into a special transmitter by phonograph in what Mr. Perry calls his "sending station" or "transmitter room." This demonstration has always been with more or less crude, hand-made apparatus.

It is here emphasized that the operation of this apparatus during these tests is such, at its perfection, that listeners cannot detect any interference between the two telephonic messages that reach either of the persons in the receiving station at the same moment over the same circuit.

Soon after making his discovery Mr. Perry became convinced that telephonic duplexing would first find its greatest utility on isolated, single metallic-circuit lines longer than those usually found within city limits. Therefore since 1908 he has been engaged in researches leading to much longer distance voice duplexing transmission.

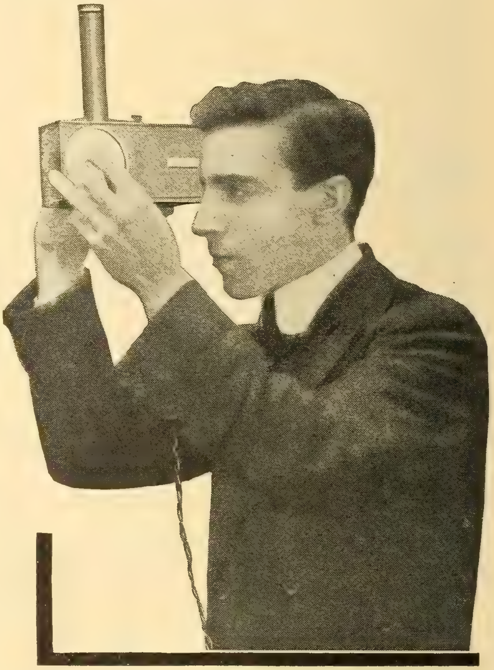
Measuring Intensity of Illumination

It is often desirable to determine the illumination of a certain room in foot-candles. Also the architect or illuminating engineer may wish to know the illumination of a certain wall or other surface. To enable this determination to be made conveniently a device known as the "luxometer" has been put on the market by a London engineer.

It measures only 7 by 3½ by 2 inches and weighs less than a pound and consists of a self-contained standardized lamp which throws a beam of light onto an inclined screen as in the Trotter portable photometer.

It may be stated that there is a mirror, from which the central portion of silvering has been removed, which is viewed through an eye-piece and is set at such an angle that it reflects into the eye-piece the inclined screen above mentioned. The eye therefore sees in the field of view, a small annular patch representing the inclined screen and the central portion which is cut away. Through this central portion the object of the illumination of which is to be determined is viewed. The angle made by the inclined screen with the rays of light, is variable by means of a milled head and is adjusted until the illumination of the central and outer parts of the field of view coincide on the well-known Trotter principle. The illumination of the object viewed can then be read off on a direct reading scale graduated usually from 0 to 4 foot-candles.

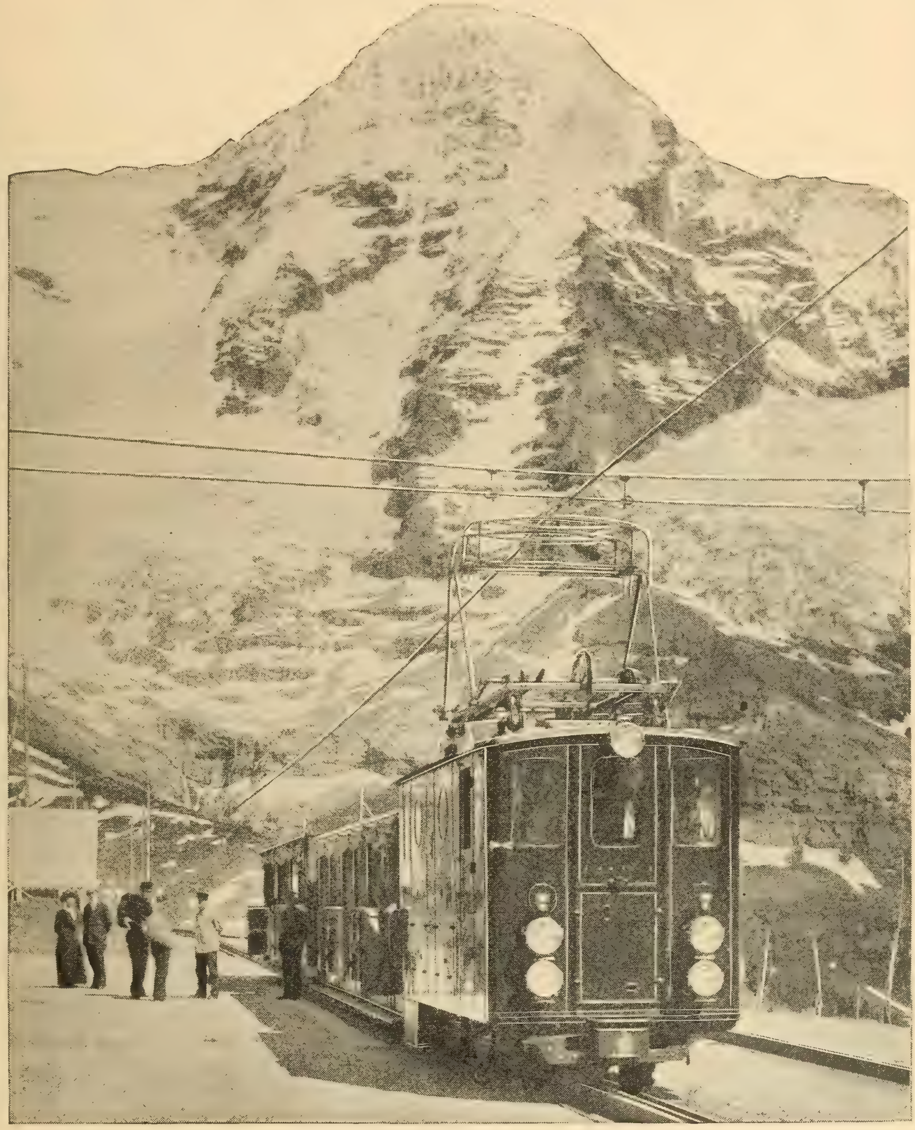
When it is desired to determine the intrinsic brilliancy of a surface the above procedure is followed and the same can be done by viewing a surface placed horizontally in case the horizontal illumination at any point is required.


MEASURING INTENSITY OF ILLUMINATION

Preserving Telegraph Poles

The Imperial German Postal Department has conducted extensive experiments with various impregnating materials to preserve the life of telegraph poles. It finds that if zinc chloride is used, the life of the pole is about twelve years; with copper sulphate, it is fourteen years; with corrosive sublimate, seventeen years; while if treated with tar oil, the pole will last 22 years.

For the year 1910 the Chicago Telephone Company reports the greatest growth in its history, the net gain in the number of telephone stations being 37,641. In the city of Chicago the total number of telephone stations connected to the exchanges of this company now amounts to nearly 240,000, and in the suburban district there is something over 60,000, giving a total of about 300,000 stations in the territory served.



AN ELECTRIC TRAIN IN THE ALPS

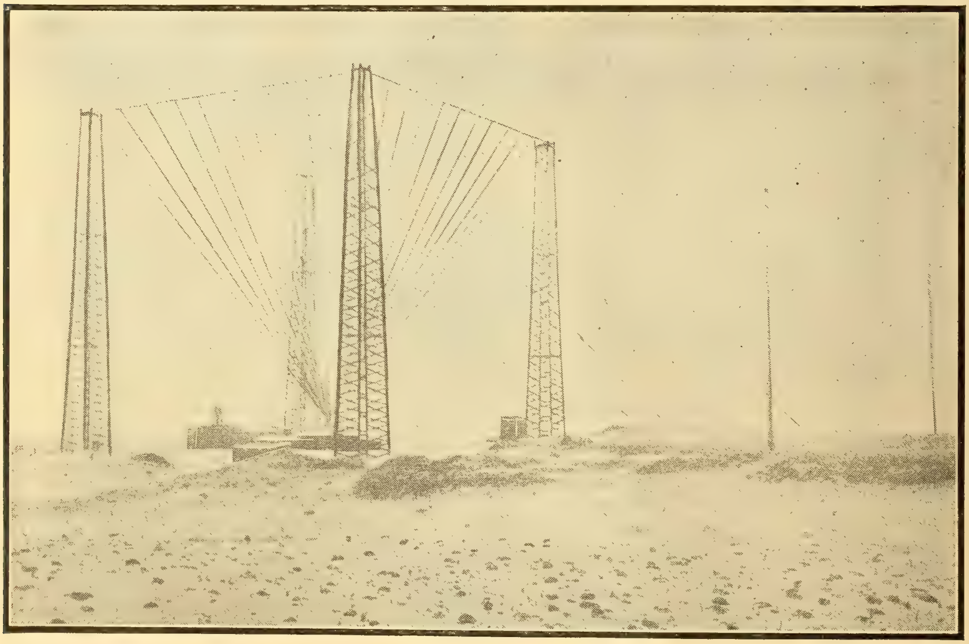
Above is a view of one of the electric trains on the famous Wengernalpbahn in Switzerland. This mountain railway is operated by direct current of 1,500 to 1,800 volts and the locomotive climbs slowly up the steep grades by means of a rack and pinion. Two cars are drawn at a load, each seating 48 passengers. A speed of about ten miles an hour is possible on the 25 per cent grade. The train is heated and lighted by electricity. By means of automatic brakes the train may be brought to rest in from 2½ to 6½ seconds

Journalism of the Sea

By F. M. SAMMIS

A few years ago, when a man was worn and nervous from the strain of his business, it was customary for his physician to recommend an ocean voyage for his rest and refreshment. During his trip on the water he could enjoy absolute rest from his business worries, but nowadays there is no such thing as freedom from business for the man of affairs. Each morning on his journey across the ocean he finds beside his plate at the breakfast table a newspaper printed on board containing the latest news of the day. While he may have resolved to forget entirely the things left behind, it is more than human nature can resist to leave untouched the little sheet and he is soon eagerly perusing the happenings of yesterday or glancing at the quotations of his pet stocks. There is not even the excuse that he happens not to have the change to purchase a paper, for they are distributed gratis to every passenger, for like other newspapers, they are made profitable by means of their advertising columns.

The machinery necessary to make possible the publication of a daily paper in mid-Atlantic is very much the same as that required for any of the great city newspapers, except, of course, on a much smaller scale. There is, however, one marked point of difference and that is in the manner in which the news is transmitted to the editorial room. The material for the *Atlantic Daily News* is furnished by the tremendous organization known as the Associated Press, which has a representative in every news gathering center of the earth ever on the alert for items of interest to telegraph to New York. Every day in the year at 8:30 p. m., a special dispatch is prepared at the Associated Press office in New York and telegraphed direct to the Marconi Station at South Wellfleet, Mass. From here, by means of wireless telegraphy, the news of the world at large is sent out to vessels hundreds of miles distant on the broad Atlantic. The aerial wires supported by the masts of each steamer intercept a sufficient number of the ether vibrations sent

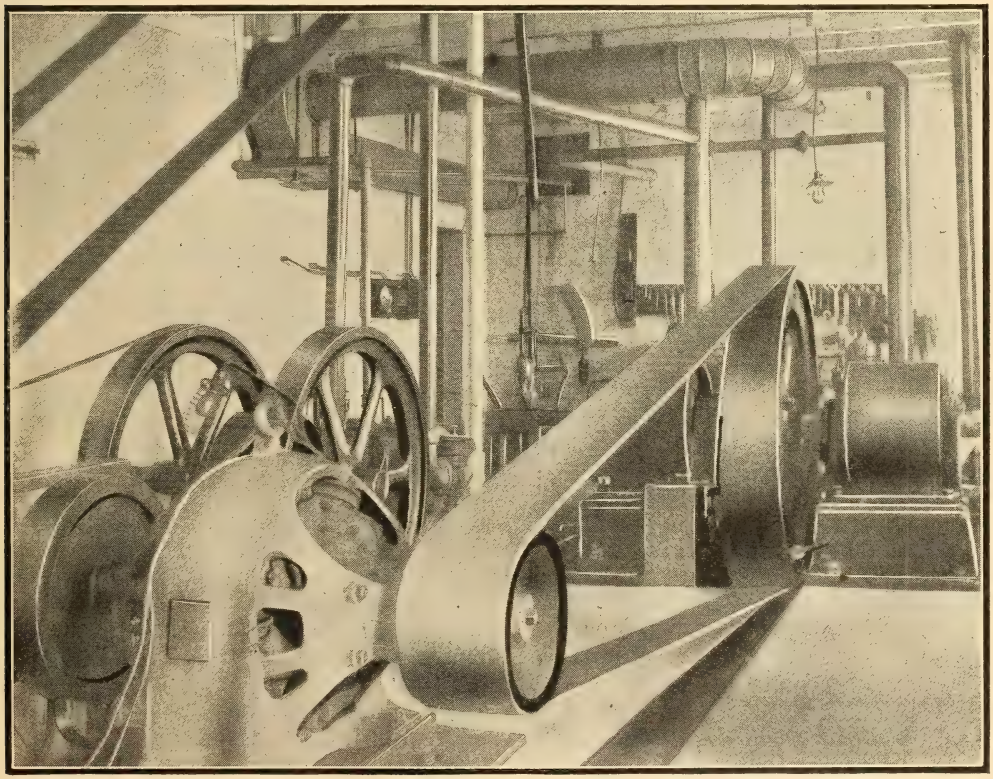


FOUR HUGE TOWERS 215 FT. HIGH SUPPORT A GREAT NETWORK OF COPPER WIRES

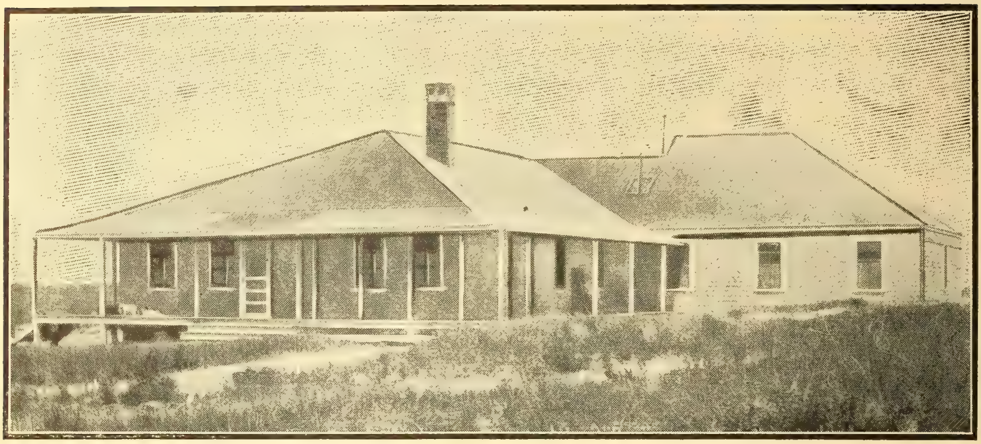
ENGINE AND TRANSMITTER HOUSE OF THE WELLFLEET STATION

out by the Cape Cod transmitter to operate the sensitive receiving apparatus, the operator records the message and in the morning the traveler finds at his place the news that has come so far and has been printed while he slept.

Perhaps, it might be interesting to know something of this station on Cape Cod, the methods by which the news is transmitted and the little company of men who form the working force. The plant is located about two miles from the railroad station at South



A POWERFUL ENGINE AND DYNAMO ARE NECESSARY TO PRODUCE THE ENERGY FOR LONG RANGE WIRELESS WORK



BUNGALOW IN WHICH THE WIRELESS OPERATORS LIVE

Wellfleet and is situated directly on a huge sand bluff that overlooks the Atlantic Ocean. There is little here but sand, the kind that stays awhile and then moves on. In fact, it is not uncommon for some of the buildings to be almost buried during a single storm. A species of coarse grass alone succeeds in drawing nourishment from the sand, and to this vegetation, Cape Cod owes its existence, for without it, the Cape would long since have been blown away.

Four huge towers, each 215 feet high, support a great network of copper wires, the lower ends of which lead into the transmitting room. These wires, when charged, set in vibration the ether for 1,500 miles around. Under the shade of these towers nestle the several buildings of the plant. A low brick structure houses the great puffing engines and humming dynamos that furnish the power necessary for the transmission of messages to great distances. Under the same roof is also located a storage battery of colossal size and a machine shop. Connected to this building by a long corridor are the transmitting and operating rooms, in which occur the wonderful display of electrical pyrotechnics that has caused the plant to be dubbed "Marconi's thunder factory."

About a thousand feet from the plant is situated the comfortable little bungalow that shelters the men employed at the station. There is a plank walk from the plant to the house and many are the tales told of trying to keep to the path on a stormy night when the ground is covered with snow and the air full of blinding sleet, or of endeavoring to reach the bungalow when there is a ferocious wind storm blowing that drives the loose sand against the men's faces with such force as to almost bring the blood. On one occasion during a heavy storm, the manager became confused in attempting to make the passage from the house to the plant and only succeeded in reaching his destination by following the wire fence which encloses the grounds for its entire length.

The bungalow in which the men dwell is as pleasant and cozy as one could wish for. There is a large living room, furnished with comfortable chairs and couches. The walls are hung with pictures and on the tables are scattered books and magazines. Most of the men endeavor to play some musical instrument and, whatever the result may be, there are no neighbors to complain. They have an excellent phonograph and a great number of records. They had a rule that whoever was guilty of profane language had to pay a fine for each offence and this money was used to buy records; or if any of the men went to Boston for a little vacation, they were to buy a half dozen records for the privilege. Each man has a bedroom to himself, there are two guest rooms, the manager has his larger room and office and there is a very pleasant dining room.

The happy family, for it is a happy family, consists of a manager, two telegraph operators, two engineers and two old salts as riggers, a chef and steward and two dogs, Missy and Mike. The manager is the technical man and wireless engineer of the plant, in addition to his position as head of the family. The two telegraph operators take shifts in working the land lines and wireless circuits, for the station is also used for communication with Boston shipping. The engineers stand watch alternate nights to start the main engines of the plant and to keep them running smoothly. There are also a thousand and one things for them to do during the day—some repairing, improvements to be made or experiments for the engineer at the head office in New York. The riggers keep the towers and stays in ship shape. They may be seen almost any day, perched far aloft, tightening a rope here, replacing a fouled wire of the antennæ there, putting in their time wherever it may be most needed. Painting the towers is a job that keeps them busy for many weeks at a time with extra men to help.

The chef or steward is the one man who has it in his power to make the family either happy or miserable, and misery is little known here. It requires considerable foresight and good management to keep the larder well supplied at this out of the way place and many of the provisions must needs come from Boston. With some help from the town store, the wares of local fishermen and an occasional mess of flounders caught from the bank by the men when off duty, the commissary department is kept well supplied.

The men gather for a late breakfast in the morning, for some have been up until two o'clock on duty, and then starts the business of the day There are various tasks to engage the men during the daytime, but it is at night that the real work of the station begins. At 8:30 p. m. the operator on duty hears a call on the land wire, and he is at once busy copying on his typewriter the news dispatch from the Associated Press. He then takes his copy down to the plant and starts punching the strip. This operation is one recently added to the daily regime and is the means by which the entire news message is sent automatically in perfect Morse characters without the operator touching a key. In order to insure the receiving of the message by the ships at sea, many of which are at distances too great to ask for repetitions of certain words they may have missed, the entire news dispatch is repeated several times. In the days when the operator had to send this long message four times by means of a huge telegraph key, in addition to receiving it from New York over the land line, the news became rather a bore, especially when the hours of the morning were small and the man's eyes heavy for sleep. The message having been punched on the paper, the strip is then wound on a reel attached to the motor-driven automatic transmitter and is then ready for the program, which starts at ten o'clock each night and continues until completed.

At 9:30 o'clock the engineer on watch hastens down from the dwelling house to the plant and starts three great flaming torches, in order to heat the ignition balls of the kerosene engines. Oil engines are used in this plant because of the high cost of coal and the difficulty of delivering it at the station. By 9:50 o'clock all is in readiness—the engines are running and the recording instruments are inspected to note whether the current value is correct. When the clock points exactly at ten, a red signal light flashes in the engine room, the operator releases the catch on the automatic transmitter and the crashing noise of the spark is immediately heard in the adjoining room. Here in the transmitting room great streams of fire a foot long are thrown out by powerful blowers and the tremendous noise of the spark, though musical, is terrifying. Very few persons have seen this plant in operation for visitors are strictly prohibited from entering upon the premises, but one may hear the high pitched note of the powerful spark for several miles, if the night be quiet or the wind favorable.

Through the windows of the station the spark has been seen for fifteen miles at sea. Viewed from the exterior, the intense white flash showing through the ground glass windows of the instrument room and the deafening crash of the spark would cause one to believe that here is the home of the evil one. In this way the great plant is calling to ships near and far and sending them the news of the day. The ships may be 1,500 miles or only 100 miles away, and unless the vessel is at the greater distance, the operator usually copies the complete dispatch correctly the first time without recourse to the repetitions that follow.

While the operator at Cape Cod is busy sending out the day's dispatch on each one of the numerous ships on the broad Atlantic there listens an attentive ear, and the ear must needs be attentive if it is to catch the message, for while the waves are tremendously powerful when released from the towers at Cape Cod, they travel equally in every direction and the amount of energy received by a ship

1,500 miles distant is infinitely small.

Between the masts of each vessel are strung horizontally several stranded copper wires about the diameter of a pencil. These wires are separated by wooden spreaders and carefully insulated by special hard rubber insulators from the masts and their attendant stays. Several vertical wires are connected at the center of the horizontal ones and these lead directly through an insulator into the wireless cabin; usually located on the upper deck.

The modern Marconi cabin aboard ship is divided into several sections. There is usually an inside companion way for the convenience of passengers and this leads into a reception room where messages may be filed for transmission. Directly adjoining this reception room is the main portion of the wireless cabin where the man on watch answers the thousand and one questions propounded to him by fair passengers, while those not so fair must content themselves with a somewhat more brief description of the wizardry of wireless.

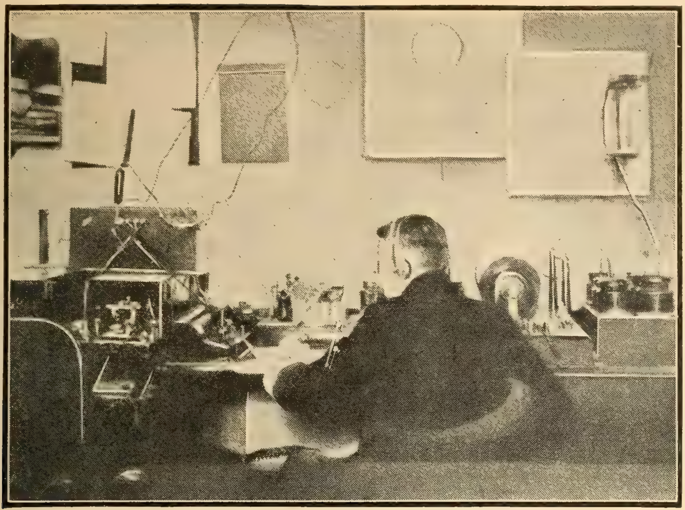
A sample of the efficacy of explaining wireless to a passenger is well illustrated by the story of an operator who, in the days in which the received signals were recorded on a paper strip, had particularly prided himself upon an especially lucid description of the *modus operandi* of wireless telegraphy to a fair passenger. Upon thanking him for his courtesy, the lady remarked that she understood it all perfectly, but would he tell her how the paper tape reached the ships from shore without getting wet.

Next to the main room is the living room of the two operators and it is as comfortable a little cabin as there is on the ship. There are two berths, a writing desk, a chair or two, and in fact, all the comforts of bachelor life. At meal time the men repair to the main saloon and dine with the passengers or, if business be heavy, as it often is on the larger vessels, the meals may be served by the steward in the Marconi cabin. There are two other and much smaller rooms opening from the main cabin. The first contains the entire wireless equipment used for transmitting, while in the latter is located the receiving apparatus. Here are the special and sensitive instruments in which we are particularly interested. This room is especially constructed with sound-proof walls several inches thick and lined with cork. These more modern accommodations are in marked contrast to the quarters on the older vessels with which the operators had to content themselves. They were limited to one small room which contained the wireless apparatus and a berth. There was barely room to turn around in and, if perchance, the Marconi man was of the long variety, the chances were his feet extended under the instrument table when he turned in for a few hours sleep.

Each night, a few minutes before ten, the operator in charge shuts himself in the little sound-proof room, provides himself with pad and pencil, adjusts the pair of telephone receivers to his head and awaits the stroke of ten. Exactly on the minute, the faintest little whisper is heard in the telephones. The giant spark at Cape Cod is saying, "Good evening, ships, Good evening, ships." This spark, which was so terrifying at the station, is so weak at 1,500 miles as to be indiscernible by anyone but an operator who has become expert by long practice. These signals, though faint, are quite distinct and may be likened to the gentle purring of a contented kitten, though they are not so loud. Quite recently it has been discovered that the human ear is more sensitive to a higher musical note than that which was produced by the spark formerly in use, which was at the rate of 4,000 sparks per minute. The new musical spark has a frequency of 36,000 impulses per minute and is readable at considerably greater distances with the same power.

In the meanwhile, with receivers tightly pressed against his ears, the operator is rapidly writing down pages of news. This continues for about an hour, at the end of which time the dispatch is complete. The copy is then quickly transcribed on the typewriter and hurried down to the "editor on board" of the *Atlantic Daily News*. One of the first things required of the editor of a newspaper is the ability to write a paragraph from a single sentence and to construct a whole story from a single paragraph. This Atlantic Daily editor must likewise have the faculty of making readable articles from the abbreviated news of the telegraphic dispatch. To a novice, this message received on board, would be almost unintelligible.

When the copy is ready it is turned over to the typesetter who prepares the type in the good old way in vogue in newspaper offices before the advent of the linotype machine.

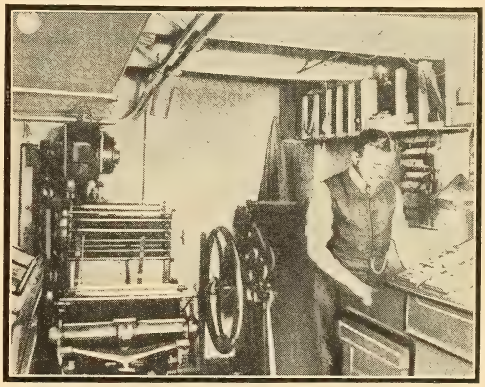


RECEIVING A WIRELESS PRESS DISPATCH ON BOARD A TRANSATLANTIC LINER

By long practice he has become very deft, and in a short time all is complete and passed over to the printer for his part of the work. The forms are rapidly adjusted to the motor-driven press and soon the copies are being taken off and folded for distribution the following morning. For the first half of their journey across the Atlantic the ships receive their news from the station at Cape Cod and the latter part of the time from the station at Poldhu in Cornwall, England.

The first wireless newspaper to be published on board a vessel crossing the Atlantic was a little sheet known as *The Transatlantic Times*. It appeared November 15, 1899, and was published on board the American line steamer St. Paul, enroute for England. On this voyage the St. Paul carried Marconi and two of his engineers, returning from America where they had been carrying on experiments with a new kind of telegraphy. The particular object of their visit had been to report the yacht races for the Associated Press and as success had crowned their efforts, they were looking for new worlds to conquer. They decided to publish a newspaper on board ship and obtained the latest news of interest from the Marconi station at the Needles. The papers were neatly printed and were sold at a dollar a copy for the benefit of the Seamen's Fund. From this small beginning, the idea gradually grew until the erection of high power stations at Cape Cod and Poldhu made possible the constant reception of news from land and a daily issue filled with up-to-the-minute happenings.

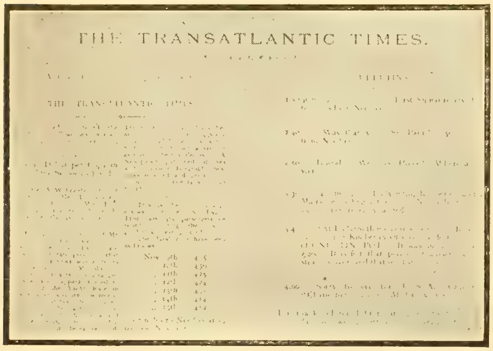
The *Atlantic Daily News* is a paper from eight to ten pages and is printed in the form of a magazine. On the out side cover there is a copy of some famous painting, a photograph of some prominent man or an illustration of some article within. As the paper is distributed to all passengers without charge it is necessary to pay for its printing in some manner and, as is the case with other magazines and papers, this is done by the advertising which appears in its pages. Many of the best hotels and shops have their names appearing in the *Atlantic Daily News*. There are many items of interest in the paper, news from all parts of the globe, the quotations of the stock exchange, the latest gossip of the sporting world, the abstract of the ship's log, the evening's program of music, etc. Like the great metropolitan papers, extras are sometimes issued of important news and on the bulletin board is posted election returns, etc.



PRINTING THE ATLANTIC DAILY NEWS

The papers are most eagerly sought after by the passengers and they are scanned with absorbing interest. It is the great event of the day on shipboard and conversation turns to the facts that have been made known by the advent of the little sheet. Of course, the barest facts are all that can appear in news dispatches that aim to send as much information as possible in as short a form as is commensurate with making sense. The whys and wherefores that brought about a certain event are talked over in the smoking room and as the passengers pace the deck for their morning constitutional.

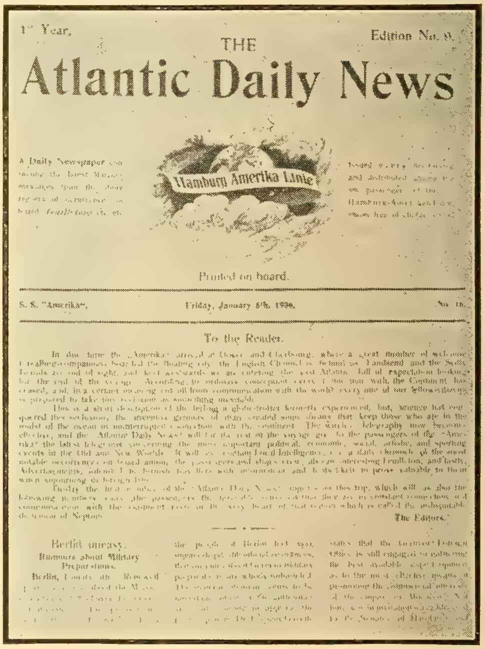
The bulletin board that is posted each day with the news of the steamer is the center of a great deal of interest and sometimes of amusement. The day's run is always noted down. Sometimes with good weather and favoring winds the vessel may have made unusually good time, or it may be, that with a head wind and other bad conditions she may not have been able to make her usual number of knots. The names of the steamers with which the wireless operator has been in touch are noted down, with any news of importance that he may have received from any of them. The passengers scan the horizon with great interest for a sight of the wonderful icebergs or enormous school of whales that are reported as having been seen by a nearby steamer. There is a feeling of pity, not unmixed with awe, when there is reported a derelict near at hand and the man on watch does not cease for a minute his close scrutiny of the waters ahead until he feels that his vessel is out of danger from these perils of the sea.



THE TRANSATLANTIC TIMES.

VOLUME I, NO. I, OF THE TRANSATLANTIC TIMES—FIRST WIRELESS NEWSPAPER EVER PUBLISHED

For the last five years newspapers have been published daily on the Atlantic liners. From the individual efforts of the steamship companies, each of which printed its own paper with its own title, has developed a publication with an issue of several thousand copies daily, with a single management for all the lines. This insures uniformity of issue and increases the advertising value. Some idea of the high esteem in which advertisers hold this little newspaper may be had by the fact that for a single page as much as four or five thousand dollars per year is obtained. For certain classes of select advertising this price is not high, for this is a medium that is placed in the hands of people of means for a week and the results are well worth the price paid. Year by year the paper has grown to its present size, and in these coming days of thousand-foot liners with swimming pools and elevators, who shall say that even extras and Sunday magazine supplements may not soon be the order of the day.



1st Year.

Edition No. 8.

THE

Atlantic Daily News

Hamburg Amerika Linie

Printed on board.

S. S. "Amerika". Friday, January 5th, 1906.

To the Reader.

The Editors.

FIRST PAGE OF THE WIRELESS NEWSPAPER NOW READ ON ALL THE LARGE TRANSATLANTIC LINERS

* * *

The Flying Scarab and the Seventh Heaven

By **RENE MANSFIELD**

IV.

Click!—Kent's hand fell to his side. Both men turned about quickly. They had forgotten the girl. She was bending over Kent's camera concernedly. "Oh, I don't know what I've done, Mr. Mercury. I do hope I haven't broken anything," she cried contritely. "I was trying to operate the shutter—this is the shutter, isn't it?—and this little screw thing snapped. How careless of me!"

"Doesn't make a particle of difference," Kent assured her exuberantly, "not a particle. Nothing matters—nothing in the world. By Jove, it's wonderful—it's marvelous! You'll think I'm crazy, Miss Daphne—but you see, I've won out. I can do it—what I've been working at for years." His face was alight with the first brief glow of attainment, his eyes rested on the little indicator on the rough table.

The girl saw the unconscious twitch of his fingers, impatient to be at the work he loved—the longing in his eyes to go over each step that had led to the result he had attained.

"You will have work to do," she said at once. "I must return. It is getting late."

He insisted that he should accompany her to the Seventh Heaven. As they started up the sandy path again Butler followed them with his eyes, an odd expression on his serious face. They had gone but a little way beyond his ken, when the girl, who had kept well in the lead, paused until Kent reached her side. "Mr. Mercury," she said, with a sudden charming shyness, "will you please to go on till you reach that maple up there—then look straight west, till I—till I get there." He looked at her, puzzled.

"No turning into oak trees or laurel bushes," he warned.

"It's my shoes and stockings," she said. "I've simply got to get the sand out."

When she joined him at the big maple he noticed for the first time that she was still carrying his camera. He was quite overcome with chagrin that in the blind exuberance of his spirits he had failed to relieve her of it before.

As they reached the great green velvet throne of the Seventh Heaven she turned to him suddenly. "Thank you so much for your kindness. You've been kinder to me than you know. I—I shan't get to the Seventh Heaven again."

Kent stared at her stupidly. "But—but, Miss Daphne——" he could think of no overwhelming reason to submit for her coming. "Oh, see here," he cried with a sudden inspiration, "aren't you at all interested in this—this discovery of mine?"

"Interested? I'm dying of curiosity! I supposed you didn't wish to——"

"If you should happen up here tomorrow I believe I can show you something that will amaze you—that will make those big eyes—"

She frowned. "I should very much like to witness any phenomena you might produce," she said with crushing formality, though her lashes flickered imperceptibly, "if you would be good enough to explain them to me."

Kent regretted that he had obtruded the little personality. He was properly contrite, and begged her to come the next day, when he would tell her himself of the discovery which would shortly be the world's property. He was immensely flattered by the parting remark she trilled back at him as the low-hanging branch swung back into place: "You really couldn't keep me away."

"Say, Kent," said Butler that night abruptly, "are you blamed sure that camera wasn't loaded?"

"What if it was?" Kent returned. But he picked up the camera from where he had laid it when he returned from the Seventh Heaven, and opened the back of it. There were no films in it. "You're crazy, Butler," he said shortly.

V.

The girl sat in the tree crotch swinging her brown shod feet nervously and twisting the end of the braid that hung over her shoulder into a great curl that shone like copper when the sunlight filtered through the leaves.

Not a sail skimmed the surface of the placid lake—not a bird winged its way across the brilliant blue of the sky. It was very warm and breathless. The girl noticed that a slim little shoot quite at the edge of the cliff where vagrant breezes might be enticed, seemed perfectly motionless. She scanned the horizon anxiously. There was not a fleck of cloud or the shadow of a bird that might be mistaken for the Flying Scarab. She took a book from a hollow in the tree, which seemed to hold other articles, too, and began to read. She had read all of a paragraph, when suddenly she thrust the book back into the recess, slid to the ground and sat down, Turk-fashion, close to the edge of the cliff.

The white speck that she had discerned moving quickly across the sky like a tiny pilot balloon in a gust of wind, was now taking form. The girl appreciated the aptness of the name which the aeroplane had been given. It looked like a huge scarab with silken wings outspread and metal body gleaming. She remembered that to the Egyptians the scarab was the symbol of immortality. There was something fitting about that, too. In what had man's infinity been so demonstrated as in this century-old effort to touch upon the very shores of infinity?

Straight toward the Seventh Heaven the Scarab was heading. Its shadow streaked the lake with a wavering line of indigo. But instead of the aviator dipping his elevators to glide down to the clearing as the girl had expected, he shut off the rear propeller engines, and starting up the motor of the helicopter-sustainer, hovered perhaps a hundred feet above the cliff.

"Watch that little sprig," shouted Kent presently to the girl who was almost beneath him. She turned her eyes to the lone little shoot she had noticed before at the very edge of the cliff, outlined scrawny and straight against the blue of lake and sky. Every leaf seemed still. As she looked, wondering at Kent's purpose, a great butterfly poised itself for a moment and then settled on a leaf.

"Watch!" Kent called again.

She watched. And in a moment she thought a breeze must have sprung up suddenly. The leaves stirred. The gorgeous wings of the butterfly swayed. Then the girl uttered a startled little cry. As though a blight had fallen upon it from the sky, or as though an invisible hand had stripped from it in sudden fury its sturdy new leaves, the little shoot stood barren against its vivid background of blue. The butterfly lay lifeless among the fallen, shriveled leaves. The twigs and slender branches drooped, and the whole skeleton of the shoot seemed about to crumple into nothingness.

The girl turned an awe-struck face up to the man in the Flying Scarab. She thought of stories she had read about Hindu magic and wonder-workers. She wondered if she had been hypnotized. In another moment the Scarab had descended and Kent, scarcely waiting for the wheels to strike the earth, leaped from his seat and ran to her side.

"You saw it?" he cried excitedly, "the butterfly and all-? Isn't it amazing—isn't it wonderful, girl?" The girl sat down limply on the grass.

"I tell you it will revolutionize warfare—it will revolutionize civilization. It is stupendous—it is inconceivable! Do you grasp the importance of it?'' he asked her, almost roughly.

"Yes—yes, I think I do," she said faintly. "But how—the principle—the——"

Kent, succumbing to a boyish abandon of enthusiasm, flung himself on the grass beside her and explained as best he could to an unscientific mind the theory of the phenomena she had just witnessed. He drew rough diagrams for her on scraps of paper and the backs of envelopes. He outlined briefly the principles of the X-ray and also of the Hertzian waves as their activities are disclosed by the wireless telegraph. He tried to make it clear to her how he had fused the underlying elements of those two forces—how he had been able to focus etheric wave lengths into an invisible beam so powerful that all forms of life were destroyed when subjected to its rays.

"And this is only the beginning," he said. "It is like comparing a sling shot to a Gatling gun to compare what you have seen with what experiments will develop. A whole country can be devastated—a whole army cut down by this invisible force——"

"But, oh," began the girl, "what a hideous, barbarous——"

"So hideous and barbarous," he interrupted, "that the dogs of war will be kept muzzled—and kept muzzled tight. The more barbarous we make war the less we're going to have of it."

"And it is you who will tighten up the muzzle to the last notch. What a famous man you are going to be, Mr. Mercury!"

Kent smiled. He couldn't tell her that fame was already much of a bore to him.

"Not till tomorrow, anyhow," he replied. "I'm not giving it out to the press until this

"GOOD-BY, MR. MERCURY. GOOD LUCK"

afternoon. I think there are four reporters down at camp now waiting for me." He grinned boyishly. "We got ahead of 'em this trip—they were all up in the air till Butler saw fit to let them know where we were."

The girl had arisen suddenly. "I must be going on," she said hurriedly. "I have been here longer than I intended. You have been so good and patient about explaining things to me. Good-bye, Mr. Mercury. Good luck."

"But see here—you can't go like this, you know. Can't you tell me where I may see you again—may I—won't you——"

She interrupted his stammering petition with an odd little laugh. "Mr. Kent"—he remembered afterward that she had called him Kent—"Mr. Kent, I'll let you know in the morning!"

"Really?" he exclaimed delightedly.

"Really." She traced a cross above her heart with the tip of her finger.

"I'll be here!" he assured her with enthusiasm, as she started down the little path to the road. A ripple of merry, tantalizing laughter came back to him through the dense foliage of the trees.

VI.

The next morning, when Butler sauntered into camp, having walked to the village and back for some copper wire, shaving soap, and coffee, he stopped short before Kent, who was lying before the tent smoking, and regarded him with fine scorn. "Stung!" he said briefly.

"Huh?" inquired Kent indifferently.

Butler removed a sheet of the *Daily Sun* from his pocket and thrust it beneath Kent's nose. Kent gazed down the Roman ridge of it and sat up suddenly. "How the devil—how the dev——"

Most of the front sheet of the *Sun* was devoted to an account, fully illustrated, of Kent's Discovery of Death-dealing Rays; Mystery of Disappearance Explained; Perfecting Most Notable Scientific Achievement of the Century."

There was a picture of Kent seated in the Scarab; there was another of Butler and Kent before the tent of their camp, and also a most remarkable one showing Kent at the culminating moment of achievement, standing by the table where lay his apparatus, with his hand grasping Butler's shoulder in unconcealed joy.

"Stung!" repeated Butler, emphatically. "And by a petticoat!"

Kent paid no attention to the other's disgusted remarks. He was reading the story carefully.

"By George, Butler," he cried, when he had finished, "do you know that's mighty well done—and what a scoop! Those fellows yesterday were all on the evening papers. By the way, it's kind of queer the fellows from the other morning editions didn't show up. What a scoop—Good Lord!" Then he laughed long and loud until Butler was goaded into throwing a large neat pile of quilts at him. "But, Butler," he roared, "she used my own camera—I stood around meek as Moses while she snapped to her heart's content.—Oh, Lord!—I insisted upon carefully explaining everything under the shining sun. I implored her to permit me to demonstrate the thing. Butler, that girl's a wonder—she's a wonder, I tell you."

"I had my suspicions," remarked Butler. "If you had listened to me——"

"Oh, hang it all, Butler, what's the odds? I'm glad the girl got the scoop. By the way, I'm going back to town tomorrow. Yep. I've got a little business to transact with the *Daily Sun*."

When he strolled into the outer office of that newspaper the next afternoon the small boy behind the pink sheet behind the desk was overcome to the point of speechlessness upon recognizing the aviator.

"I wish to see the young woman who wrote that story about me yesterday," Kent repeated slowly. "No, not the editor, Miss—Miss——" he hesitated strategically.

"Mis' Dawson? Yessir. I'll fetch her right 'way, sir," the boy finally responded, darting into the inner rooms. He returned shortly to say that "She was in the library, room 403, right there, sir, yessir, thank you, sir."

Kent found the girl alone in the library room looking through the files on the high table.

"Miss Daphne," he said softly.

She raised her eyes, shadowed now by the masses of red-brown hair piled high on her head.

"Oh, Mr. Kent," she cried earnestly, giving him no opportunity to say more, "I want you to know that I *hated* doing it—how I hated doing it. There is no excuse. I know there is none. But somebody had to get it eventually. I hadn't been here very long—and I wasn't making good. My father wrote me that when he was sailing one day he noticed that somebody had set up camp just below my Seventh Heaven. I seemed to be sure at once that it was you—I don't know why. I had to make good, or lose my position. So I tracked you down. And I so nearly lost as it was. You didn't give me quite time enough"—she smiled deprecatingly—"I had to bribe father to meet the Morning men at the railroad and drive them to the Seventh Heaven by the thirty-mile route. Of course when it got too late to turn in copy for yesterday, they went back to the village, and found that the evening men had returned with the story. It was reprehensible—it was——"

"But, my dear Miss Dawson, I'm not in the least put out. I liked it, I assure you

Liked it immensely. And I want to tell you you're the aptest pupil I ever had."

Constance Dawson laughed happily.

"Oh, but you should have seen the dreadful books I had poked away in the crotch of that old tree, along with—cameras and films and things," she added, "in case of emergency."

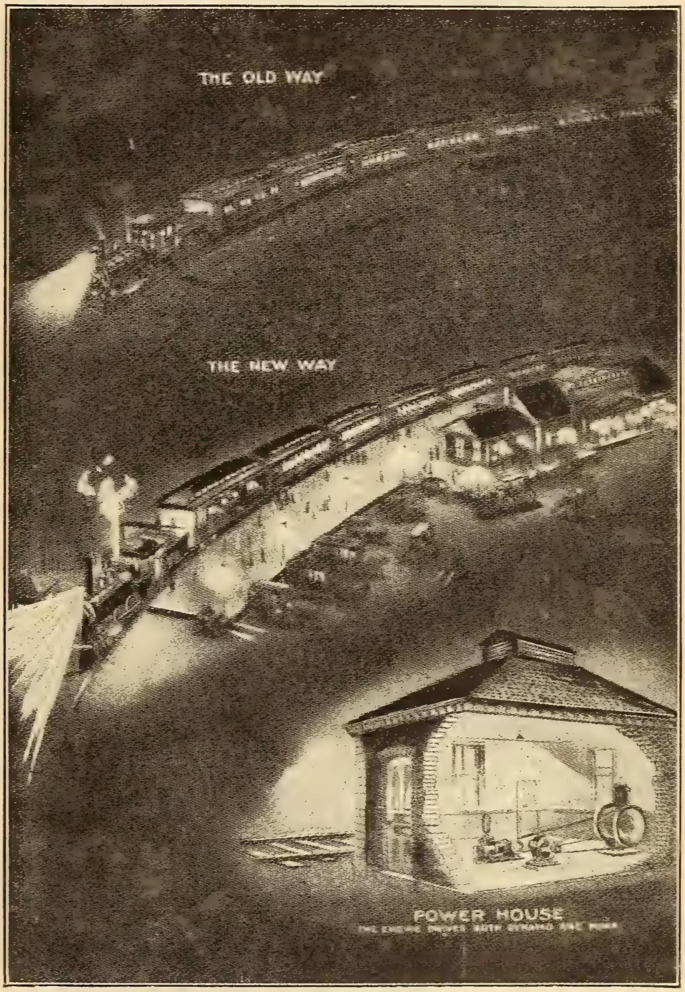
"You can't say that I wasn't perfectly tractable," he laughed back. "Simply delighted in putting my neck in the noose—head in the lion's mouth, as it were. I hope in view of my past amiability, Miss Dawson, you will let me call upon you tonight, where we can take the matter up in greater detail?"

The girl looked at him startled. Then she said quietly, "I'm sure we should be delighted to have you. We live at the Albermarle. I am—you know I am Dawson's wife."

Dawson? Dawson? The name seemed oddly familiar, but he couldn't quite place it. Then, suddenly, he remembered.

(The End.)

COUNTRY RAILWAY STATION LIGHTING



THE OLD AND NEW WAY OF LIGHTING COUNTRY STATIONS

As indicated in the accompanying illustration the old way of lighting the railway stations and platforms in country towns was by means of kerosene lamps but since the wonderful development of the gas and gasoline engine and the tungsten lamps a more modern method is employed utilizing electricity for this service.

The new way as shown in the lower portion of the illustration consists of a power house equipped with a gasoline engine driving a dynamo as well as a water pump, the electric generator supplying electric current for lighting the depot, platform and yard, and the pump, either operated directly from the gas engine by belting or by electrical transmission, if located at a distance, the electric motor driven pump supplying all the necessary water for the station, the railway locomotive water tank and similar service.

The gasoline engine driven electric generator and pump may be started at a moment's notice and is most economical in operation, no steam being continually kept up for pumping service as when steam boilers and steam pumps are utilized for this service, the electric lighting feature being added with very slight expense in first cost as well as maintenance.

Electric Block Signaling

By SIMON DEUTSCH, E. E

PART IV

Of the many applications of the track circuit, perhaps the simplest and still the most interesting, is its use in connection with the highway crossing alarm, a means of giving protection at public highway grade crossings from approaching trains.

To properly protect a highway crossing from approaching trains on a double track is a very simple matter, as the train movements on each track are in one direction only, and it therefore only requires a track circuit extending from the approaching side as far as the street crossing, no special relays or features being necessary. The alarm is generally sounded when the train is 1,000 to 3,000 feet from the crossing, continuing until the train arrives at or passes the crossing. The circuit diagram of a crossing alarm for double track movements is shown by Fig. 12 (train movements on each track being only

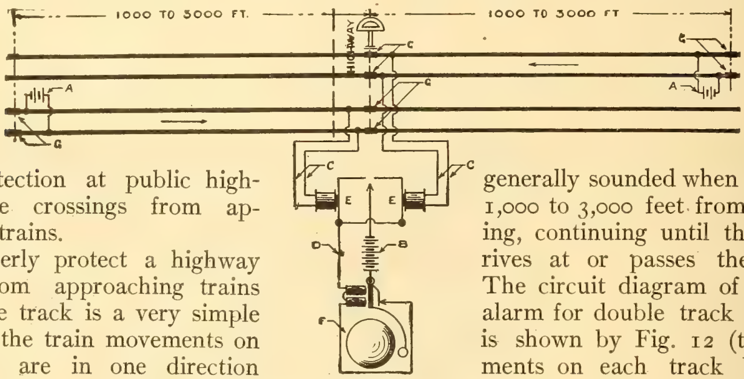


FIG. 12. CROSSING ALARM CIRCUIT FOR DOUBLE TRACK MOVEMENTS

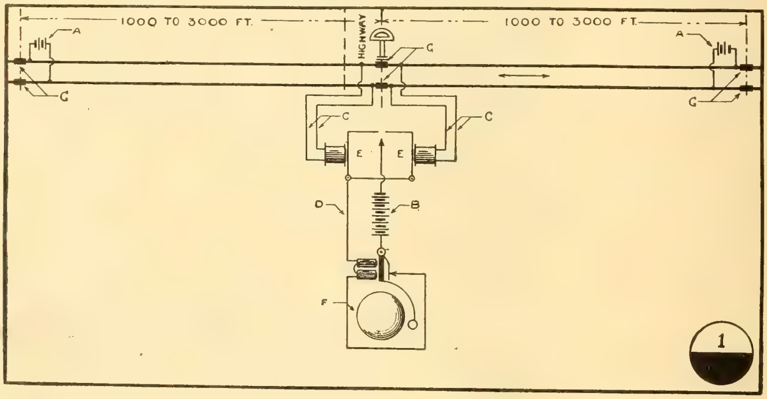


FIG. 13. CIRCUIT FOR PROTECTING CROSSING ON SINGLE TRACK

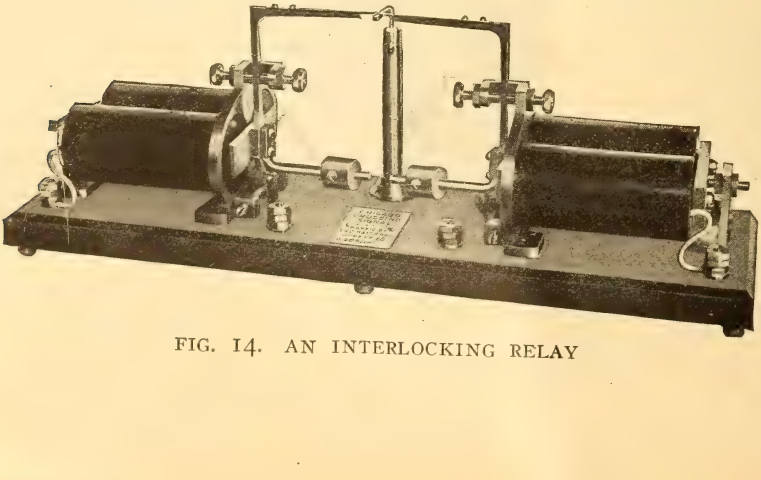


FIG. 14. AN INTERLOCKING RELAY

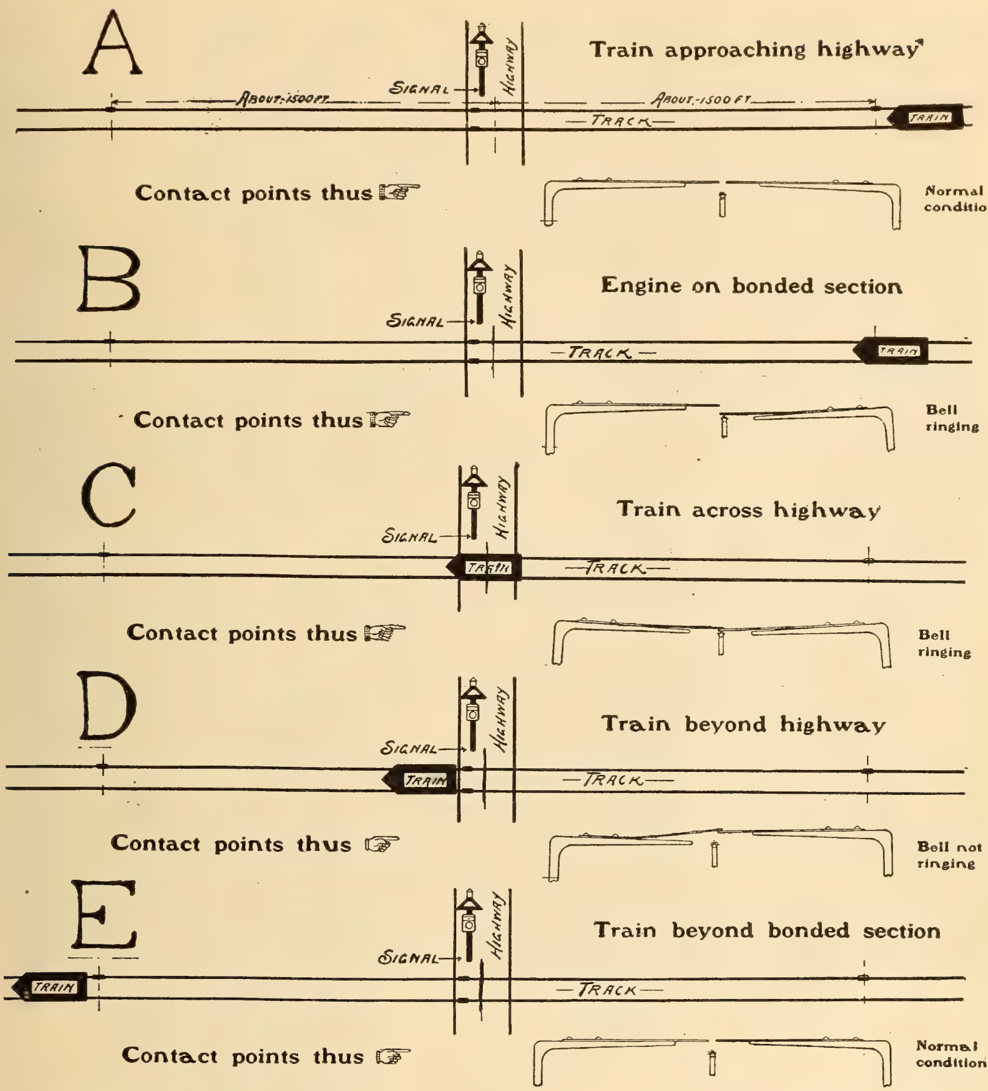


FIG. 15. SHOWING POSITIONS OF CONTACT POINTS AS A TRAIN APPROACHES AND CROSSES A HIGHWAY

in the direction indicated by arrows) and it can be readily appreciated how any ordinary electro-magnet having an armature on which is mounted a contact, can, by being de-energized when a train is on the track circuit, close a local bell circuit, and thus sound an alarm as long as the train approaches the crossing or remains on the track circuit.

From Fig. 13, which shows the circuit diagram for protecting a crossing from single track movements, it will be noted by the arrow indications, that trains operate in *both* or *either* direction on the same stretch of track. Unless the alarm is sounded only when trains are *approaching* the crossing, the crossing alarm becomes a nuisance and menace to public safety, as an alarm sounding when a train is *receding* from a street crossing is unreliable and soon disregarded.

It therefore is necessary to provide a means of automatically silencing the bell as soon as a train has passed the crossing, regardless of the direction from which it approaches, and in addition to sound the alarm for following trains. This is accomplished by means of interlocking relays, a form of which is shown by Fig. 14, the method of interlocking of contact points and resulting conditions being clearly defined by Fig. 15, A to E inclusive.

From previous description of the track circuit, it will be understood how a train approaching the crossing will upon entering on the track circuit, short circuit the batteries normally energizing the relays, or electro-magnets, and through resulting contacts being made or broken, indicate its approach. By reference to circuit diagram of Fig. 13, and part A of Fig. 15, the normal condition of all parts will be noted. A train approaching the crossing, by de-energizing one side of the double coil interlocking relay, causes the contact point on its armature to assume the position shown by B, Fig. 15, thus completing the bell circuit, which is a local circuit. On reaching the crossing the train bridges both track circuits, whereupon the contact carried on the opposite armature falls on top of the first contact mentioned, corresponding to position C, Fig. 15. As soon as the train has passed by the crossing, at which point the two track circuits are separated, the first mentioned track circuit being now clear, the coil connected to same is again energized, and by drawing up its armature, the contact with the middle post, which is one side of the bell circuit, is broken, and the bell is silenced, this being shown by D, Fig. 15. As the train proceeds and passes beyond the limits of the track circuit, all conditions are again restored to normal, as indicated by E, Fig. 15.

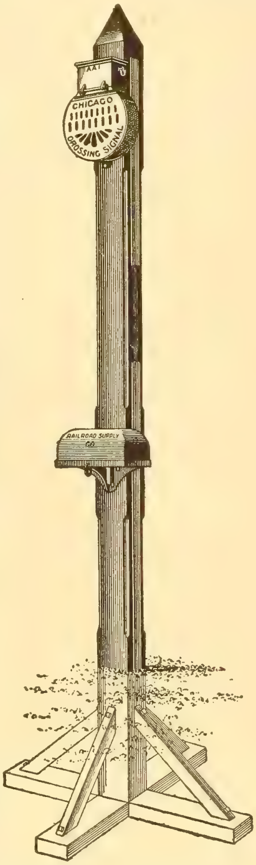


FIG. 16. CROSSING SIGNAL COMPLETE

The equipment generally placed at the street crossing consists of the bell, relay, relay box, and bell batteries, as shown by Fig. 16, which makes it a simple matter to wire up the equipment and localize all operating parts so that in case of trouble it is a simple matter to test out all parts of the local circuit or track circuit.

(To be continued)

The Cruiser

His home is not the sea, but the forests. Clad in a felt hat, heavy flannel shirt, with shoes and trousers to stand rough usage and miles of tramping through paths that have known only the redman, he is truly a "child of the forest." He carries a gun and hatchet at his belt, often using the latter to cut his way through the underbrush. His blankets, food and cooking utensils are carried in a substantial bag on his back. As he walks and walks his practiced eye scans tree after tree and when a certain section of timber has been carefully scrutinized, he can estimate to a nicety the number of telephone and telegraph poles as well as the amount of lumber of various kinds the section will yield.

THE CRUISER

A Demolished Power Plant

On January 6th, a tremendous explosion occurred in the plant of the Minneapolis General Electric Company, blowing out the walls and demolishing the machinery. This was followed by a fire which completed the work of destruction, as seen in the illustration. Nothing was left of the expensive generators and other electrical apparatus but a tangled mass of scrap.

RUINS OF THE MINNEAPOLIS GENERAL ELECTRIC COMPANY'S PLANT

An unusual incident in connection with the disaster was furnished by the efforts of the Minneapolis *Daily News* to get current for the operation of its linotype machines. When the destruction of the power house deprived the newspaper plant of current, the Studebaker Brothers Company, located directly across the street from the newspaper office, came to the rescue in a novel manner.

The power required for the linotypes was 220 volts. In 20 minutes time the Studebaker Company unloaded from its electric trucks 105 "Exide" vehicle batteries. These were placed on a large truck which was stationed on the street just outside of the composing room. Wires were run into the building from these batteries and for the first time on record an electric automobile started to work in getting out a newspaper.

The five o'clock edition of the *Daily News* for January 6th, owed its existence to this improvised power house.

Sterilizing of Water by Ozone

The largest ozone installation yet carried out for the purification of water has just been inaugurated at St. Petersburg, at a cost of $730,000. Receiving water from the Neva, the plant passes it through filters and then through an ozonizing apparatus, which destroys all deleterious organisms. The magnitude of the installation, which has been carried out by a German firm, clearly demonstrates the growing importance of this means of purifying water for town supply.

Electrical Men of the Times

By EDWARD SCHILDHAUER

When the Isthmian Canal Commission chooses a man to go to Panama you can safely put him down as close to 100 per cent efficient. Tested out under actual working conditions, as Electrical and Mechanical Engineer of the said Commission, Edward Schildhauer has, if anything, exceeded Government specifications. Such is the position which he now holds. How he prepared himself for its responsibilities is an interesting story.

Edward Schildhauer was born in 1872 at New Holstein, Wisconsin, a town composed entirely of German political exiles due to the wars of 1848. We first find him at the age of nine years playing a cornet in public, and for several years following he earned his living in this manner. The ability to play several musical instruments also assisted later on in paying college expenses and it is reasonable to suppose that he has made some music in the Canal Zone.

He entered the University of Wisconsin in the second semester of the class of '97 and graduated with that class, receiving the degree of Bachelor of Science in Electrical Engineering. After leaving the University he was first employed by J. G. White and Company and was engaged in electric railway work in and around Baltimore. He did not remain long in the East, however, but came to Chicago in the spring of 1898, and found employment with the Chicago Edison and Commonwealth Electric Company as draftsman. Originality in handling problems soon brought him to the position of head draftsman, then to assistant electrical and mechanical engineer of the companies, since known as the Commonwealth Edison Company. As starting engineer he tested out all new apparatus put into service, and during his connection with the Edison interests the largest steam turbine plant in the world, the famous Fisk Street Station, was constructed. Incidental to his work in Chicago he secured numerous patents for devices in the electrical and mechanical field which were embodied in new designs to improve the reliability of central station service. He also, with two others, formed a company in 1902 for the manufacture of high-grade insulating compounds.

It was in 1906 that Mr. Schildhauer was offered the position of Electrical and Mechanical Engineer for the Isthmian Canal Commission, which he accepted. Upon leaving the Commonwealth Edison Company, he was tendered a banquet by more than a hundred of his fellow employees and presented with a handsome fob, suitably inscribed, showing in diamonds the number of stations and substations erected during his term of service.

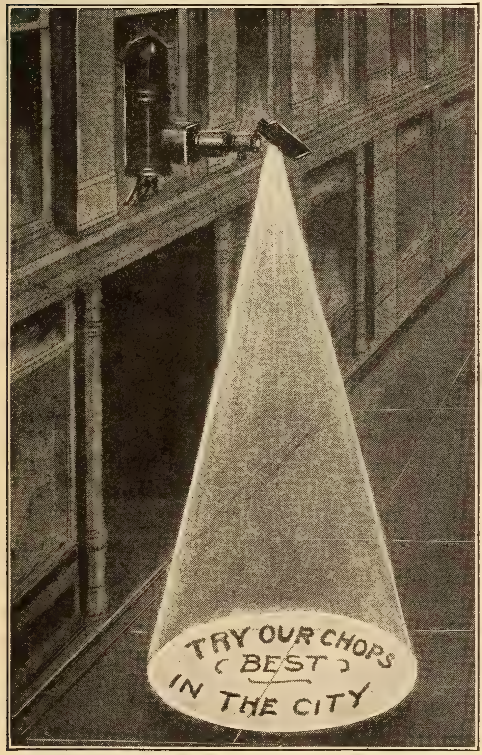
In the summer of 1907 he inspected the American and Canadian Soo locks and regulating works and made tests on the large regulating gates of the Chicago Drainage Canal at Lockport. September 1, 1907, he went to the Isthmus to continue the design of all electric and mechanical work in connection with the Panama Canal. The magnitude of this work requires original methods in solving the problems.

It is impossible here even to outline the problems which confronted this young engineer and which he has solved successfully, but he has written an interesting article for POPULAR ELECTRICITY, which appears in another part of this issue, and which gives the reader a good idea of the original methods he has devised for carrying on the great work at the Gatun locks, though only a part of the duties which have devolved upon him. To broaden his knowledge he made an extended trip to Europe, in 1908, and inspected docks and canals in England, France, Belgium, Holland and Germany.

Mr. Schildhauer is prominent in many clubs and societies, being a member of the University Club, Panama; Strangers' Club, Colon; American Electro-Chemical Society; American Society for Testing Materials; International Society of Testing Materials; Illuminating Engineering Society; American Association for the Advancement of Science; and American Civic Alliance. Best of all he is a big, clean-cut hearty American of a type which has almost completed a task which men of other nations found impossible of accomplishment.

Sidewalk Sign

This practice of using the stone or cement walks as screens upon which an advertising legend may be projected, first started in England where the darkening of the store windows after sundown meant darker sidewalks than we have in this country, and permitted such signs to be operated with lamps of moderate candlepower. Now the Germans to whose chemical researches we owe the intense brilliancy of our so-called flaming arc lamps, are using these high candle power lamps for sidewalk sign effects as shown in the illustration.



SIDEWALK SIGN

The arc lamp is situated inside the vertical cylinder and its rays are sent out through the horizontal projector. They are thus deflected downward by the oblique mirror.

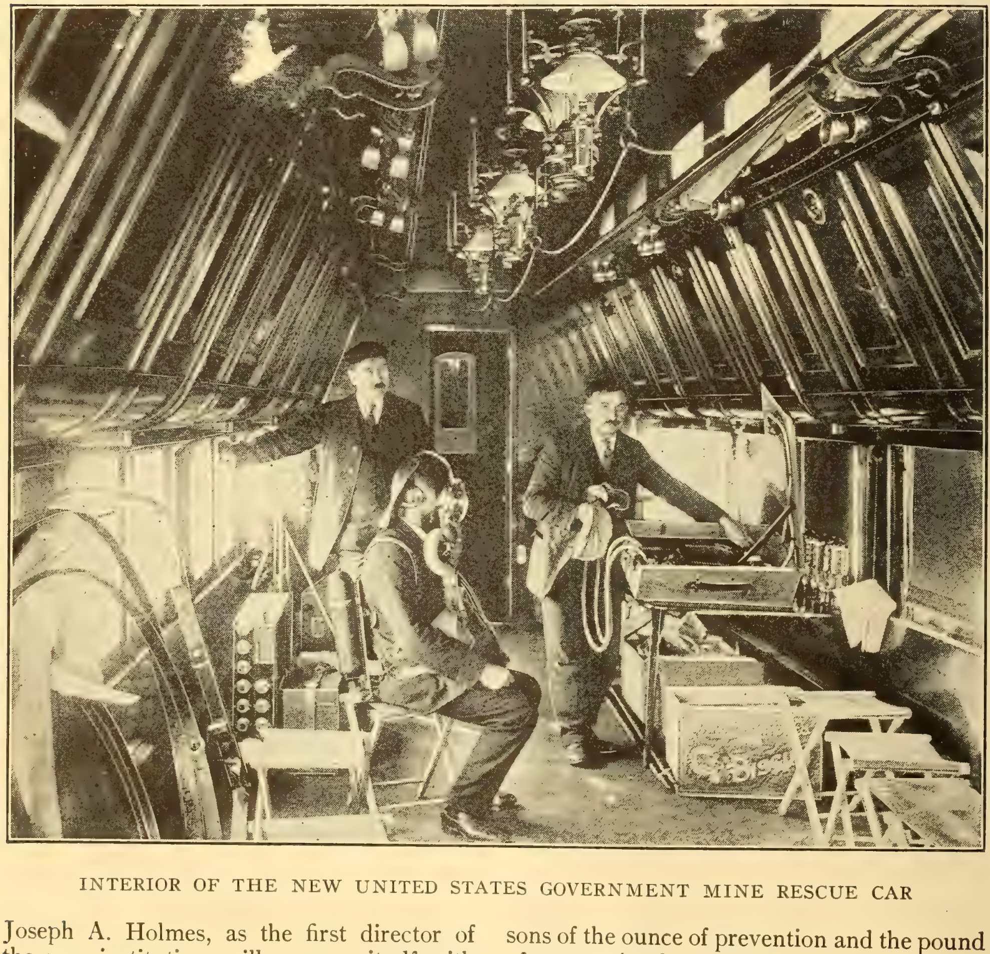
A Plea for the Operator

When the "girlie" at "Central" says "busy," don't let yourself be worked into a fret and a sweat; don't tell her in language all freckled with fire, you think her a quite near approach to a liar. Don't paw at the carpet, and don't chew the rag, nor roar as a bull when it sees a red flag, nor tell her in voicing that paints the air red, you'll have her tin-canned ere the sun goes to bed, but murmur in sugary, marshmallow words, 'twill fall on her ear as the carol of birds, to please ring you up when the line is at rest, and she raises the party of whom you're in quest, and when she replies she will do so, just hang the receiver up gently and not with a bang. You scolding old fellow, if you had to bear but half of the hello girl's burden of care, that temper of yours would explode with a boom; 'twould scatter oath fragments all over the room. They often are cussed at and growled at by men when trying to do just the best that they can to keep service moving along without hitch, when soreheads believe them asleep at the switch, and sometimes the harsh words which fall on their ears fill their throats full of lumps and their eyes full of tears. Just do unto them as you'd have others do unto a sister of yours were she one of the crew, and you'll find that your services far better will be than if by your crossness you rattle them, see? And all of the girls will pronounce you a dear, instead of an ill-tempered, sore-headed bear. Just give it a try, and if our words lack in truth you can boot us to Brighton and back.—James Barton Adams, in the *Denver Times.*

Electricity in Mine Rescue Work

By WALDON FAWCETT

Electricity is playing a most important part in the mine rescue work which is the first and foremost function of the new Bureau of Mines, the most recently organized branch of the United States Government. The Bureau of Mines which has lately been established as a part of the Department of the Interior and under the conduct of Dr. Joseph A. Holmes, as the first director of the new institution, will concern itself with the whole broad subject of mines and mining, but its especial purpose is to provide general and scientific investigations and research into the cause of mine accidents, mine explosions, etc. Bound up with this subject of mine disasters (which are nowhere in the world so numerous or so serious as in this country) is the kindred one of relief and rescue work following mine accidents, fires or explosions and it is to this "emergency work," for which there is such crying need, that the new Bureau has first turned its attention.

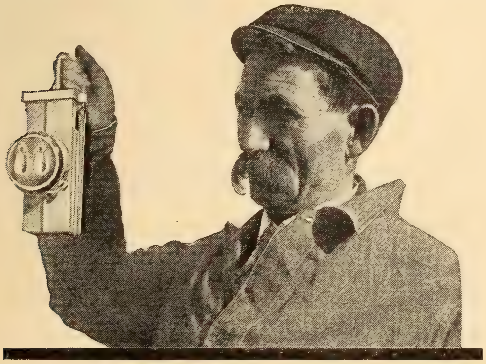


INTERIOR OF THE NEW UNITED STATES GOVERNMENT MINE RESCUE CAR

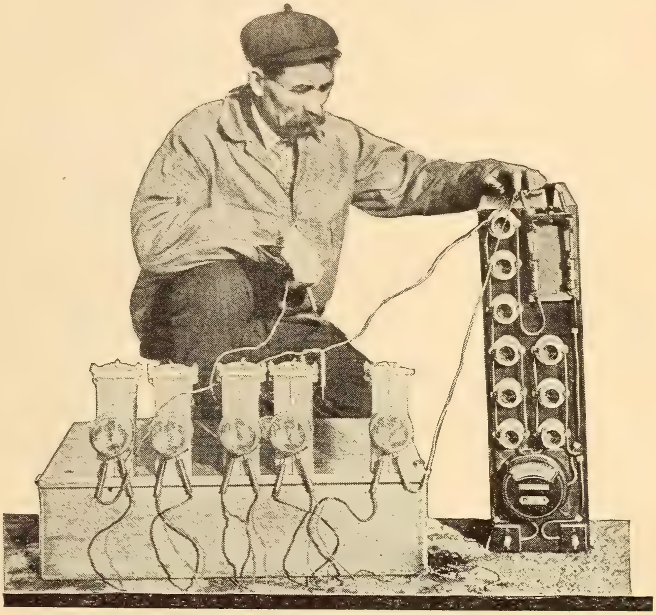
In this field the government experts are seeking to teach simultaneously all the lessons of the ounce of prevention and the pound of cure. As the medium of bringing about this era of better conditions there have been placed in service on the railroads of the United States a number of special cars known as Mine Rescue Cars, each carrying a carefully selected special equipment designed to meet every exigency in mine rescue work. Six of these unique cars—

all converted Pullmans—have been placed in service this winter and the full complement of eight cars will probably be in commission before this article is printed. Each car has its headquarters in the central town or city of an extensive mining district and all the principal coal-mining regions of the country are thus brought in close touch with one or another of these portable "branch offices" of the new Bureau.

Each car, the exact duplicate of all the others in equipment, has a dual mission. Primarily it is what its name would suggest—a "first aid" car and hospital on wheels which can be rushed, literally at a moment's notice, to the scene of any mine disaster just as a wrecking train is hurried to the scene of any railroad accident. In pursuance of this purpose each car is provided with stretchers, stocked with medicines, etc., and the men who comprise the crew of each car, including a Red Cross surgeon and several men experienced in practical mine rescue work, eat and sleep on board so that the car can leave at any hour of the day or night, waiting only for a special locomotive to be attached after the receipt of a telegraphic summons.


ELECTRIC HAND LAMP USED BY RESCUE CREW

Secondary to the first function of a Mine Rescue Car only in a spectacular sense and really outweighing the other in permanent value is the use of each car as a demonstrating station or school room on wheels, traversing all the steel-tracked highways of its particular district and enlightening the great mass of miners as to mine danger and mine rescue work. It is this "missionary work" which will engage the attention of the mine rescue cars all the time except in such emergencies as they are summoned to the scene of a disaster. Each car travels in accordance with a carefully arranged schedule and a stop of several days is made at each camp or mining town visited. Lectures are given in the car or in any convenient hall to the whole body of miners who are warned how to avoid danger and given advice as to what to do in any emergency. At the same time the experts on the Mine Rescue Car are training a picked body of volunteers, at each mine visited, in the whole gamut of mine rescue work and qualifying them to use the up-to-date equipment which has been invented for such purposes—equipment which the average mine operator is glad to purchase when he has men at hand who are competent to use it. It is expected that the cars now in commission will train, all told, each year about 3,000 to 4,000 men in what might be termed "advanced work" in the rescue field.


CHARGING ELECTRIC LAMPS FOR MINE RESCUE WORK

ELECTRICALLY OPERATED "PULMOTOR" FOR MINE RESCUE WORK

It is for this demonstration work as well as for actual rescue operations that each of the new cars carries a varied array of equipment, much of it, as has been stated, being of an electrical character. Conspicuous among the utilities are a number of portable electric lamps of a special pattern. The presence in the atmosphere of a mine of poisonous gas in a proportion even so low as five per cent will result in extinguishing the flame of not only the ordinary miner's lamp but likewise that in the latest approved form of safety lamp. Consequently the electric lamps must be depended upon to furnish the illumination for all rescue work. Indeed the lamps used by the miners (even the so-called safety lamps, which no inventor has succeeded in making thoroughly fool-proof) have been the cause of so many disasters, that some experts hope for a time when electrical illumination, either by means of hand lamps or lamps conveniently placed on supports, can be depended upon for all needed illumination in the underground workings.

OXYGEN HELMET IN WHICH THERE IS ALSO ENCLOSED A TELEPHONE

There are several novel features in connection with the electric lamps on the Mine Rescue Cars. In order to conserve the current in the storage batteries the illuminating power is limited to a few candle-power, but it has the aid of a powerful reflector. Two tiny bulbs are placed side by side in each lamp. The current may be switched from one to the other in a second, but it is the intention to have one lamp burn for about four hours and the other burn for about an hour. The purpose of the dual bulbs is to have the lamp automatically give notice, so to speak, to the rescue worker using the lamp, that its supply of current for illumination is well nigh exhausted, and yet not cut off his illuminant suddenly, as would be the case with any ordinary lamp. His reserve of one hour's illumination from the second of the twin bulbs enables him to hurriedly complete the work in hand or to arrange matters for a temporary absence while a freshly charged lamp is being secured. And, by the way, the equipment of each Mine Rescue Car includes a charging outfit for charging the lamps. The outfit is portable and may be connected with any direct current. The electric lamps provided for the new cars are small but very heavy and are characterized by an almost incredible strength of construction in order to withstand the hard usage they must sustain mid the rocks and debris of wrecked mines. At a recent test an official of the Bureau of Mines hurled one of these lamps with all his strength against a concrete pavement without breaking the heavy glass eye.

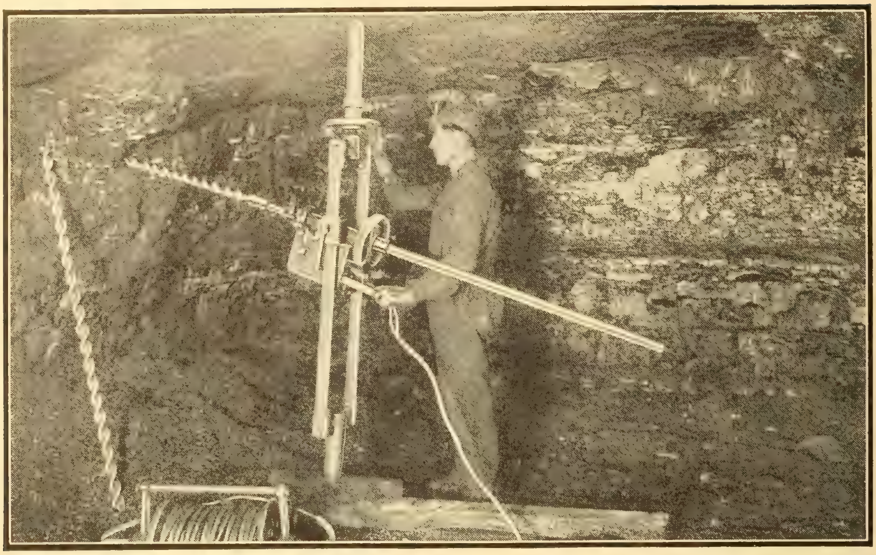
The telephone figures in the rescue outfit. There is on each car a field telephone with 2,000 feet of wire and the telephone is being made use of in the most ingenious manner in connection with the so-called oxygen helmets, eight of which, costing $200 apiece, are included in the equipment of each car. The helmet is an air-tight, armor-like covering for the head and shoulders which enables a rescue worker to descend into mines filled with noxious fumes, just as the modern diver's suit enables its wearer to live and work under water. Inside the helmet is fastened a telephone transmitter while a receiver is attached to the ear of the rescue worker when he has donned his modern coat of mail. By means of this artery of communication a rescue worker descending into a mine after a disaster is constantly in touch with the men at the surface and can send back almost momentarily reports as to the condition of the mine, the presence of fire, the location of bodies found, etc. The telephone wire, as paid out at the mouth of the mine, is marked every fifty feet so that the men at the terminus always know just how far an advancing rescue worker has progressed in his exploration of the mine and can accurately identify the exact locality covered by any of his verbal reports.

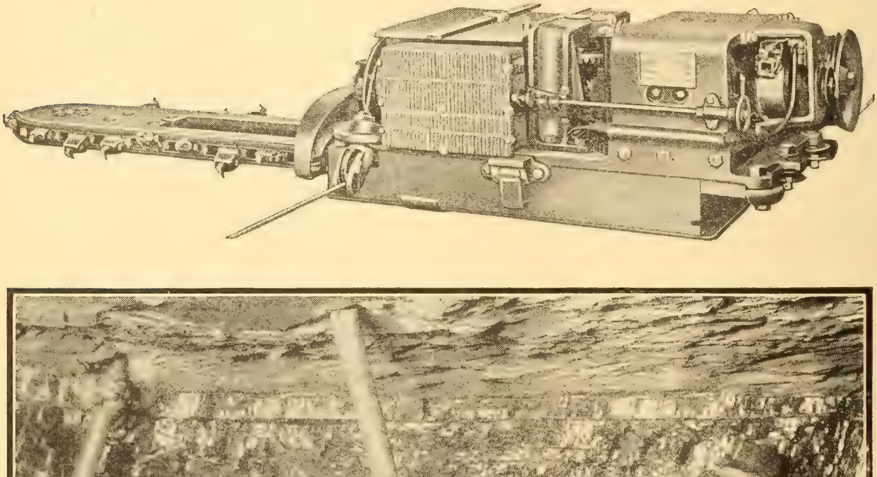
Of the electrical innovations provided for the mine rescue work, however, perhaps the most wonderful is the "Pulmoter." This is a recent German invention and the only machines yet brought to this country are the ones installed at a cost of $800 each on the Mine Rescue Cars. The Pulmoter, which occupies a wooden case somewhat larger than the ordinary dress suit case and the motive power for which is furnished by a dry battery, embodies as the principal agents for use in mechanical resuscitation several cylinders charged with oxygen, a flexible breathing bag, a flexible tube and a hood that fits over the mouth and nostrils of the patient. The apparatus can readily be carried by one man and in actual service it is carried into the mine in order that its aid may be available the minute discovery is made of men overcome by the after-gases of an explosion instead of it being necessary to delay to bring these imperiled men to the surface before attempting to revive them, as was the case under the old conditions, when the rescue workers had to rely largely upon exercising a victim's body in order to fan the spark of life.

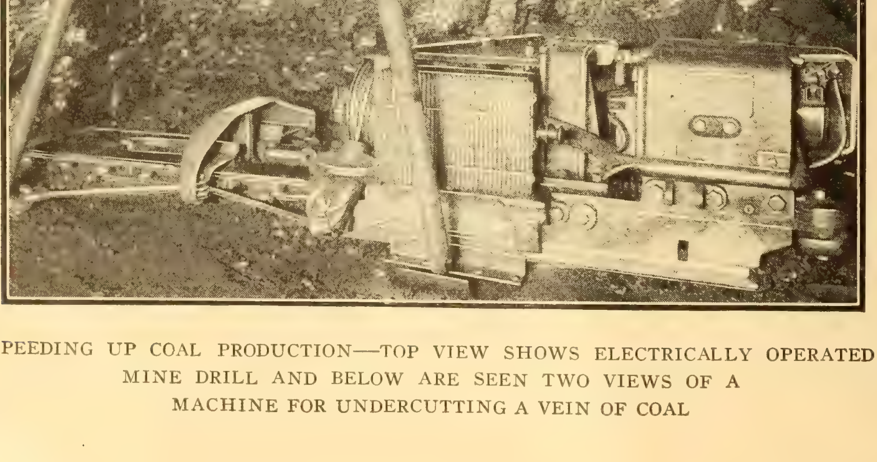
The Pulmoter might almost be denominated an automatic breathing machine, its function being to draw the poisonous gases out of the lungs and to force into the lungs, in turn, the life-giving oxygen. Its marvelous efficiency is indicated by the statement sometimes made that it will "force a corpse to breathe," meaning that it will by its alternating forces of suction and pressure compel the diaphragm to move in a body in which life is absolutely extinct. Although the new type of life restorer has been in use but a short time, it has already accomplished life-saving work that is little short of miraculous. On one occasion recently it was brought into action on four men who had been in a mine for 26 hours after an explosion and who had been passed over for dead by all of the early rescuing parties. When attention was finally turned to these supposed corpses the head, arms and legs were cold, but a rescue worker thought he detected just a suggestion of warmth in one body under the arm. The Pulmoter was brought into action, and the four men are alive and well today.

The new Bureau of Mines in addition to employing electricity in its rescue work is making exhaustive investigations as to the influence of electricity in causing mine explosions. The current is being used to so rapidly increasing an extent for the operation of all sorts of coal mining machines and would be so serviceable (if thoroughly safe) for providing a permanent lighting system for underground workings, that the new department of the government is alive to the importance of determining as speedily as possible, under exactly what conditions electricity may be safely used in mines.

The Northern California Power Company maintains wireless plants at each of its hydro-electric power plants to communicate with one another and with the home office in Redding, in case the telephone lines are down or when storms make them dangerous.







SPEEDING UP COAL PRODUCTION—TOP VIEW SHOWS ELECTRICALLY OPERATED MINE DRILL AND BELOW ARE SEEN TWO VIEWS OF A MACHINE FOR UNDERCUTTING A VEIN OF COAL

Speeding Up Coal Production

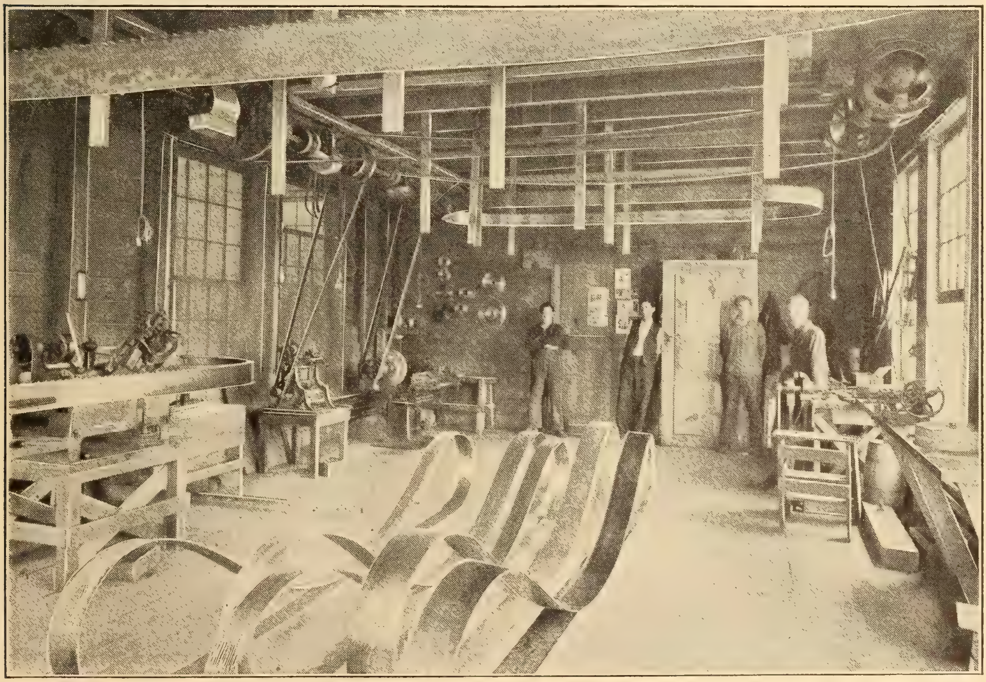
How electrically operated machines are coming to displace the miners' pick is shown in the accompanying pictures more plainly than words can describe.

If the coal is to be loosened by blasting, the drilling in the cramped quarters is no longer done in the old-fashioned way but by an electric rotary drill. As seen in one of the cuts the drill is of the portable type, the motor and feeding apparatus being mounted in a strut held between the mine floor and roof. The drill which is driven by the motor, is a sort of auger which fairly eats its way into the coal. Such a device is set up in a few moments and unlimited power is brought to it through the flexible insulated cable from any point in the mine where the permanent wiring can be reached. This wiring then reaches up hundreds or thousands of feet to the power plant on the surface. Such long transmissions would be impracticable with compressed air or steam pipes.

Then there is another machine called a cutting machine, which will undercut a vein of coal clear across its face and to a depth of several feet. This machine moves about by its own power, being propelled by a drum and cable. It not only feeds against the coal but cuts across from one side of the face to the other as the cable winds up on the drum. The long snout which projects out in front carries on its edge a series of traveling cutters or knives attached to a chain which is driven by a motor on the truck. These knives make what is known as a sump cut.

Electric Saw Filing

Electric power is utilized to special advantage in sharpening what are known as band saws; that is flexible steel saws that are formed like belts and travel over drive wheels and pulleys in a manner similar to belts. The electric motor is mounted on the ceiling as noted at the right, a small belt driving the scroll band saw filer on the bench below. At the extreme left will be noted an eight-inch band saw shapener while in the center may be seen a 32-inch American knife grinder and a 72-inch rip-saw sharpener all driven by the same electric motor through a counter-shaft and belt transmission. This method of group driving by a single electric motor is held to be the most economical for this class of work.



SHOP WHERE SAWS ARE FILED

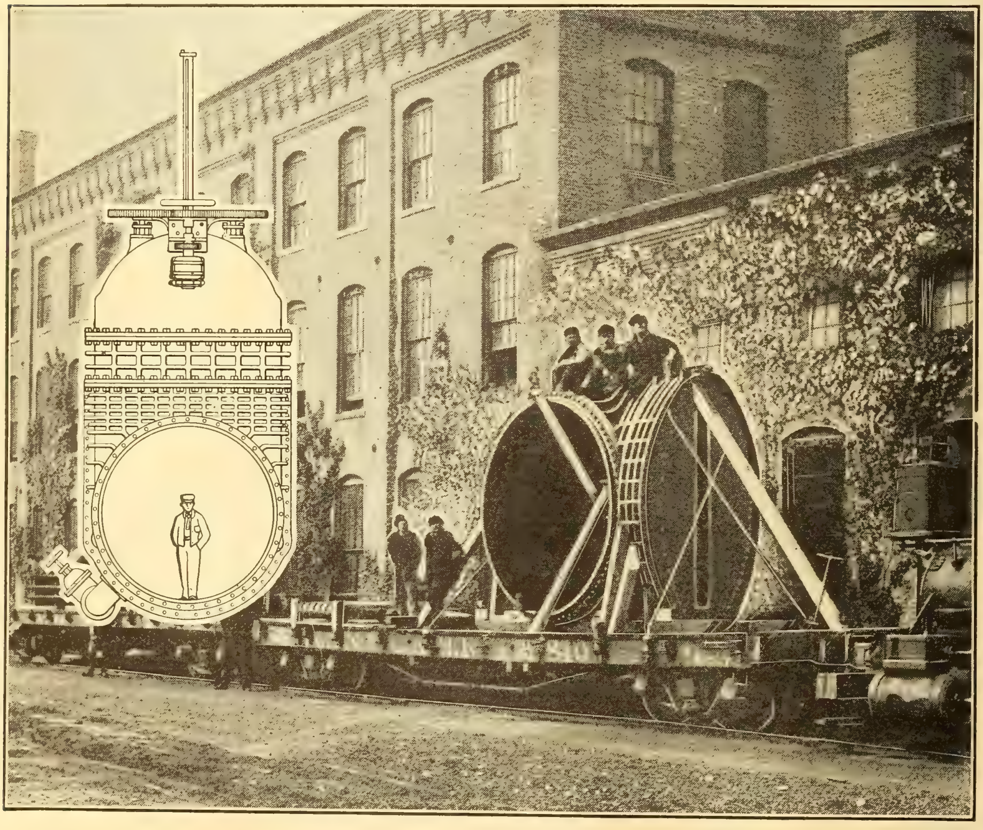
Largest Electric Valve in the World

One of the three largest gate valves ever constructed is seen, ready for shipment, in the accompanying illustration. These three nine-foot valves weigh 65 tons each and are operated by alternating current electric motors of fifteen horsepower each, three minutes being required for raising or lowering the gates which are of cast steel.

These valves are of the Chapman type designed to control the water-driven hydraulic turbines of 12,000 horsepower each at the Niagara Falls hydro-electric station of the Ontario Power Company. This largest electric valve in the world, only the lower part of which is shown on the car, without the controlling apparatus, is eleven feet wide and over 30 feet high when complete with controlling apparatus as shown in the line drawing.

It may be stated that the body of the valve is of cast iron and the valve gate which is of steel is designed for a pressure of 60 pounds per square inch or a total load of more than half a million pounds.

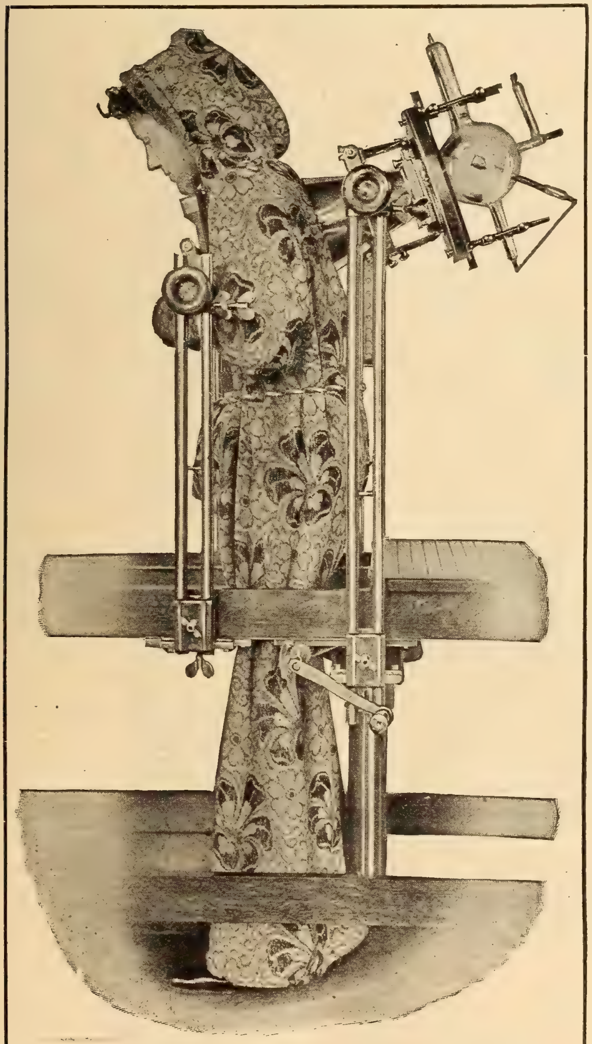
The fifteen horsepower motors drive the spindles which are over twelve feet long, through gearing. These spindles for raising the gate valve have threads of two inches pitch and are two in number of Tobin bronze, 4½ inches in diameter. There are automatic electric limit switches arranged at the top and bottom of the gate travel so designed as to make it impossible to start the motor in the wrong direction and a unique magnetic brake is provided for instantly stopping the valve gate mechanism. In case the gate is part way open the electric motor may be started in either direction, but if the nine-ton valve gate is entirely closed the electric motor can only be started to raise the gate and vice versa.



LARGEST ELECTRIC VALVE IN THE WORLD—MAIN PART READY FOR SHIPMENT

Photographing Through the Body with X-Rays

The acccompanying illustration shows the method employed in taking X-ray pictures of the interior of the body, by what is known as the compression diaphragm. The subject is held perfectly motionless in a vertical clamping device. The holder which contains the sensitive photographic plate is held against the chest. The funnel-like arrangement which is held against the back is for directing the X-rays directly through the body of the subject. The X-ray tube is the spherical, many-pronged object at the extreme right. The rays from this tube pass through the funnel, through the body and strike the photographic plate, affecting it in the usual manner. Bones, foreign objects, etc., which are more or less opaque to the rays, then cast their shadows on the plate and of course show when the negative is developed.



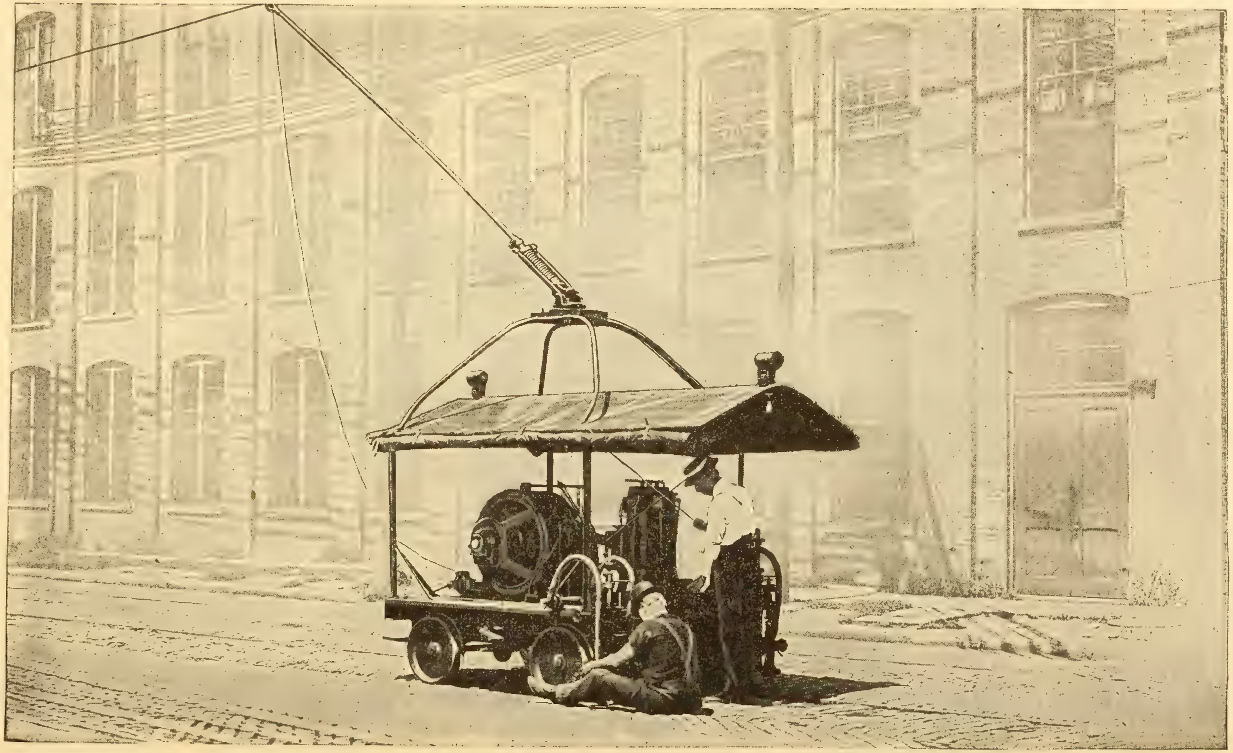
COMPRESSION DIAPHRAGM IN X-RAY WORK

Portable Lamps for Military Use

In military service officers as well as their aids have three important uses for portable lamps. First, they must be able to read the inscriptions on guide posts along the roads so as to keep their bearings, as also to light up any unexpected obstacles in the roadway. Then they must have some convenient way of lighting their maps, orders or other documents, and in consulting these they ought to have both hands free. Moreover, they should be able to light up the face of any one approaching them in the dark. But while the light should be instantly available when needed for any of these purposes, it should be turned off at other times so as not to disclose the bearer.

These requirements are all met admirably by some new German flashlight outfits built on the same principle as the common hand lamps, but carried without using the hands. Small types of these military lamp outfits have short tabs with buttonholes for attaching them to the officer's uniform, while larger ones are supported by shoulder straps. In either case the light is turned on and off by a little switch at the front of the leather case which protects the battery from the weather.

According to reports from Washington, electric locomotives will be used for towing ships through the Panama Canal locks. The locomotives will be gear-connected to the track by a middle rail cut into the form of a rack in order to obtain the requisite tractive effort. The work of installation will be done by the Canal Commission.

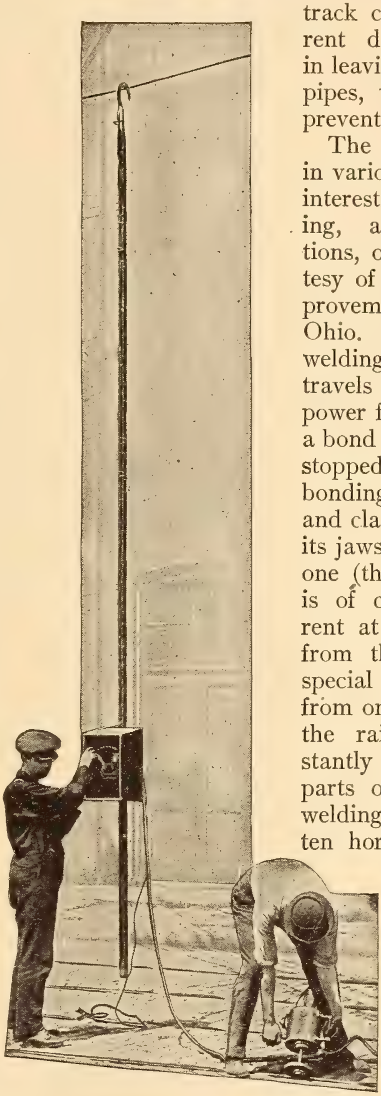


ELECTRIC RAIL WELDING CAR IN OPERATION

Electric Rail Bonding

Many have no doubt wondered why it is that car motors are able to operate from a single trolley wire, having been told that two conductors are necessary to complete a circuit. The reason lies in the fact that the earth itself forms the other side of the circuit. The earth may be looked upon as a great reservoir at zero potential, and if one pole of the dynamo in the power house be connected to the earth and the other to the trolley wire the latter will be raised to high potential or voltage (550 volts in most railway systems). Then if the trolley pole is brought into contact with the wire current will travel down the pole and its connections through the car motors to earth, through the wheels of the car. The action corresponds to that of a pump (the dynamo) pumping water out of a lake into a long pipe (the trolley wire). This water flows along through the pipe perhaps several miles. There it may be tapped and the force of the water used to drive a water motor (the car motor) and from there be discharged back into the lake when its work is done.

In the case of the lake and the pump there would not be much of a flow from the motor back to the pump again, though the same water would be used over if the process were kept up long enough. In the electrical analogy, the grounded street car circuit, it is theoretically only necessary to ground one side of the car motor. In actual practice, however, better results are obtained if the track rails are made continuous and the return current led directly back to the power house through them.



ELECTRICAL GRINDER PREPARING RAIL FOR BONDING

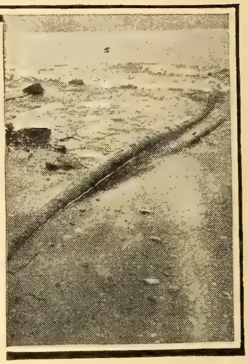
To make the track rails continuous from end to end, what is known as bonding is resorted to; that is, bridging the joints in the rails by copper conductors of one type or another welded or riveted to each side of the joint. This bonding serves another purpose. By keeping the resistance of the track circuit low, so that the current does not find an advantage in leaving the rails to follow water pipes, the electrolysis of pipes is prevented.

The bonds are put on the rails in various ways, one of the most interesting being by electric welding, as shown in the illustrations, obtained through the courtesy of the Electric Railway Improvement Company of Cleveland, Ohio. What is known as a welding car is used. This car travels along the tracks, obtaining power from the trolley wire. When a bond is to be made the car is stopped over the rail joint. A bonding clamp is then let down and clasps both rails and bond in its jaws. One jaw is of copper and one (that next the copper bond) is of carbon. An immense current at very low voltage, taken from the trolley wire through a special converter, is then passed from one jaw to the other through the rail and bond. Almost instantly the bond and contiguous parts of the rail are brought to welding heat, an energy of nearly ten horse power being employed, and a perfect weld is made.

Before the bonding is done, however, the surfaces must be made bright and this is accomplished by an electric grinder, This is a motor of size convenient to be handled and current for it is obtained by hooking onto the trolley wire as shown in the picture above. The man standing erect is working the lever of a "starting box" which controls the current to the motor operating the grinder. On the end of the motor shaft is a rapidly revolving emery wheel.

What Becomes of a Cabled Message

By FELIX J. KOCH



Perhaps nowhere, in all the world, are there more secrets bandied back and forth among disinterested listeners, than in a simple, rather neat, two-story frame building set in a little lawn, near the postoffice at North Sidney, Nova Scotia. On the outside, the structure bears simply the name of one of the great American telegraph concerns. In the lower story there is one great room filled with tables holding what seem to the layman so many telegraph instruments. You would pass it by, unheeded on your travels, were you not told of its import.

The largest part of the vital news, the movements in London stocks, and the New York markets, the cable messages to the world's great dailies and weeklies, the secret messages of kings and empires, pass from here into the waves, or, from the waves onto the long land wires.

Visitors are not relished particularly by the cable station. When they come however, and with a mission really other than curiosity, they are made welcome.

The story of the cable station can best be told in the story of a message. Messages from New York for London to come to North Sidney by telegraph. They will average ten words or less. The station here prides itself particularly on its rapid transmission of stock exchange messages, almost all of which, from the States, pass through it. In fact, most of the stock exchange business between the American and the British metropolis goes directly through here.

The New York Stock Exchange opens at ten in the morning, and if a message sent from it to the London exchange takes over two minutes for transmission, it is up to some one to explain the reason why.

Day and night they have a man standing at the North Sidney end of the wire, who takes the message down as it is telegraphed from New York. While he is doing this, another man stands at his side and copies it, word for word, at the opposite side of the little table, onto the telegraph out-bound. From there the good word goes right through to Heart's Content in Newfoundland, and so this section of the work takes practically no time at all. Arrived at Heart's Content, in Newfoundland, another man repeats the same process, as soon as the message is received, putting it, however, onto the cable, so that in London they will be receiving the first part of the message before half of even a ten-word message is all on the wire here. And, in consequence, in less than two minutes, occasionally in one minute, the message is in London. This record time is especially adapted for the stock exchange business.

As to how the stock reports are sent one can get the story best in the words of the manager at North Sidney.

"After the stock exchange opens," he says, "we average from four to five hundred messages on its wires. We have for these messages, five cables out to Heart's Content, where there is a relay, so that we get still quicker work. When the message leaves Newfoundland, it crosses the seas, and lands at Valencia, in Ireland. From there it passes over land and to London.

If the cable be a very long one, like the one which goes direct to Ireland, it takes but slightly longer to send the message. The cabling is done much as is the sending of a Morse telegram, save that as the cable is at the highest speed necessary and requires the greatest amount of accuracy, the very best operators are stationed here. Many of these men can send from 40 to 45 words a minute, and this speed will be kept up, occasionally for an hour, without their letting up. Stock exchange messages have the preference over others on the wires, but that simply means that they are given the fastest wires.

Cable operators require practice for perfection. Some of them will learn the work very quickly. They have some experts who have been classed as such for ten, fifteen, 20 years.

The average length of the stock exchange message is four to five words, and the price 25 cents a word to London. Other messages vary indefinitely in length. The press rate to London, from Sydney, is but a quarter of a cent a word. As a result the station will do from 50 to 70 sheets of press-work a day, at 50 words to a sheet. By a sheet is implied always, one of the familiar yellow telegraph blanks.

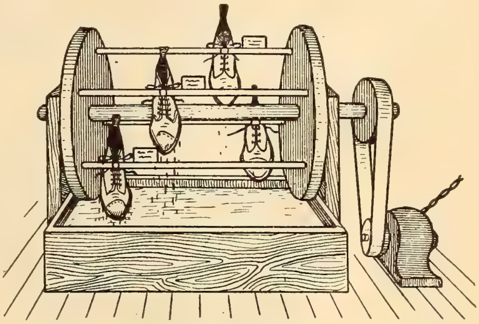
Occasionally a message will be affected by the earth-currents or an *aurora borealis*, no one knows just how. Any night that they can see an *aurora* at Sidney, they will find their wires affected. To overcome this effect then, they loop the two cables entering at Sidney and the operators at Heart's Content do the same, so that, instead of the two cables running as a pair of parallel strands, they now form one huge loop, touching one another, rather than the earth. Occasionally similar trouble will be met with on the land lines between Sidney and New York, sometimes delaying transmission for nearly a week.

In returning a message to Sidney, it is sent the same as are the outgoing ones, using the dots and dashes. As these are taken down, in the wavy writing, the message may be kept by the automatic recorder. The transmitter uses the dots and dashes, it must be recalled, when sending his message, but the dots go into waves and streaks, as they are taken down by the recorder at the receiving end of the cable. This work, however, is done by the best operators in the company's employ, this being one of the finest of their establishments. In fact, some 50 men, including clerks, checker boys and the like, are now maintained. The station has been open at Sidney ever since the cable came, 30 odd years ago. At the time of that coming, the speed for transmission was about the same as now, though nothing was quite so hurried.

When a cable is broken between Sidney and Heart's Content, the operators are able to tell just where the break is and about where in the water, lie the ends. The cable ship is at Halifax, but it is not long in port. Breaks are often caused by the anchors of ships catching in the cables. A ship, at such time, is supposed to cut its anchor, as it can then get damages from the company, but this they do not often do, preferring to cut the long line between the Continents. A cut of that sort occurs almost every spring. Or, again, the ice in the spring of the year, will crush the cable. Again, too, an occasional whale will injure it, or it may get on a rock, and, by wearing, be torn. Once the two ends are found, repairs can be made in a few hours. The ends have their positions marked by buoys, and are then spliced together. In fact this cable ship has become noted for its quick repairing, occasionally doing this work at Canso Station, under many eyes.

Advertising Shoe Polish

The illustration shows an ingenious homemade device, operated by a small electric motor, for advertising in show windows that a certain oil keeps water from penetrating the leather of a shoe dressed with it. The ease with which the shoes shed the water after each immersion as the cylinder revolves is a striking argument for "dri-feet."

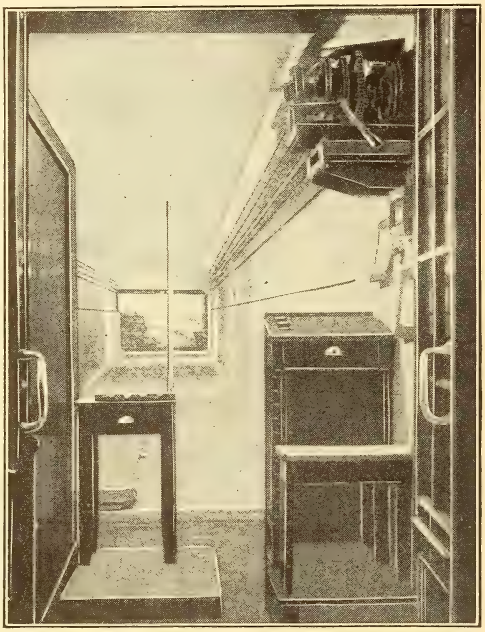


ADVERTISING SHOE POLISH

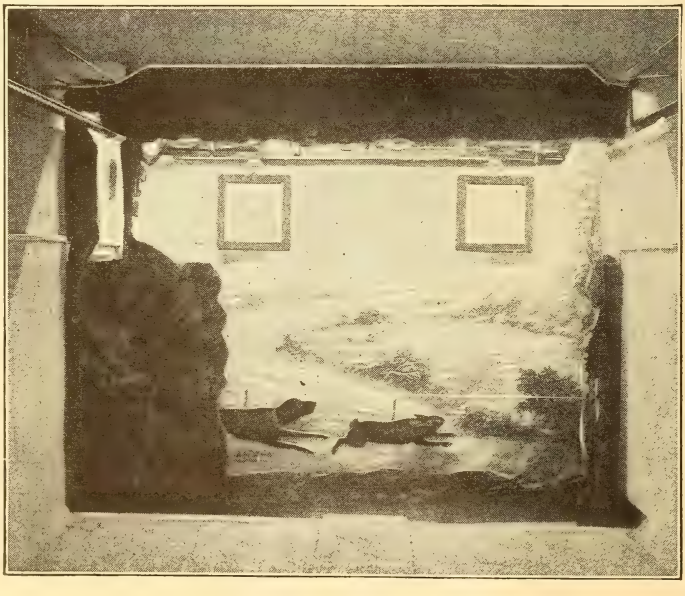
The kitchen at West Point has been thoroughly electrified. The food is cleaned and prepared by electricity. Electric heat cooks and bakes the meats, vegetables and pastry. Electric power does the work of cleaning the dishes, sharpening the knives and polishing the silver.

Moving Targets Electrically

When a new rifle gallery was planned for the "Landwehr" officers in Charlottenburg, Germany, it was suggested that instead of taking the recorder to the targets, the latter be brought close to the marksmen after each round of shots. This novel idea was carried out by Engineer Zickel of the Elektro-Apparatebau Company, who equipped a pair of parallel shooting galleries with a system of wire ropes for bringing the targets back to the firing end. During the firing, the targets are quietly suspended at the farther end of the gallery, fully a hundred feet off and the recorder, whose desk is beside the marksman, jots down the approximate result of each shot. After each series of from three to six shots, the recorder throws a switch on the motor above his head, thereby moving the endless cable which carries the targets and which runs over pulleys in a narrow passageway between the two parallel alleys. This starts the target back towards him, making the trip in twelve seconds and automatically stopping the motor when it reaches the recorder's side. Then the exact imprint of the shots can be noted by both the marksmen and the record keeper without the possibility of a dispute, after which the shot marks are covered with paint or pasters. When started back by a reverse throw of the switch, the motor again is stopped automatically when the targets have reached their normal position.



MOTOR AND SWITCH FOR CONTROLLING TARGETS



MOVING TARGETS ELECTRICALLY OPERATED

Instead of the bullseye targets, metal figures of game can be hung from the moving cable and this can be arranged to move the game across the end of the shooting gallery at a fair speed. In one case, such a game alley has been fitted up by the same German firm with a double cable, allowing the operator to send the figures across the gallery in either direction. The figures used for this purpose are interchangeable so that the sportsmen never know what animal will show up next nor from what direction it will come; but he does know that the moving figure will appear at his end of the gallery in a fraction of a minute.

The Auristophone

The auristophone is an electric hearing device for the deaf or partially deaf. It consists of a transmitter, pocket battery, and receiver, the latter being placed to the ear of the person who is hard of hearing. The grand opera Auristophone, as the name indicates, is an opera instrument and is said to give a more voluminous and full tone than the ordinary device, for the reason that the receiving instrument used is of the duplex type.

USING THE AURISTOPHONE

It is asserted that this device enables those mildly afflicted and who ordinarily can hear music or speaking at a distance of only a few feet, to hear well in the fore part of any church, theatre or auditorium, without having wire connection with the pulpit stage or platform.

It is claimed also that the Auristophone improves the hearing by massaging the inner organs of hearing without air compression and without tiring the ear while all the ordinary trumpets and other instruments for the deaf compress the air within the auditory canal against these organs, tiring the ear and even causing severe injury.

A Recording Compass

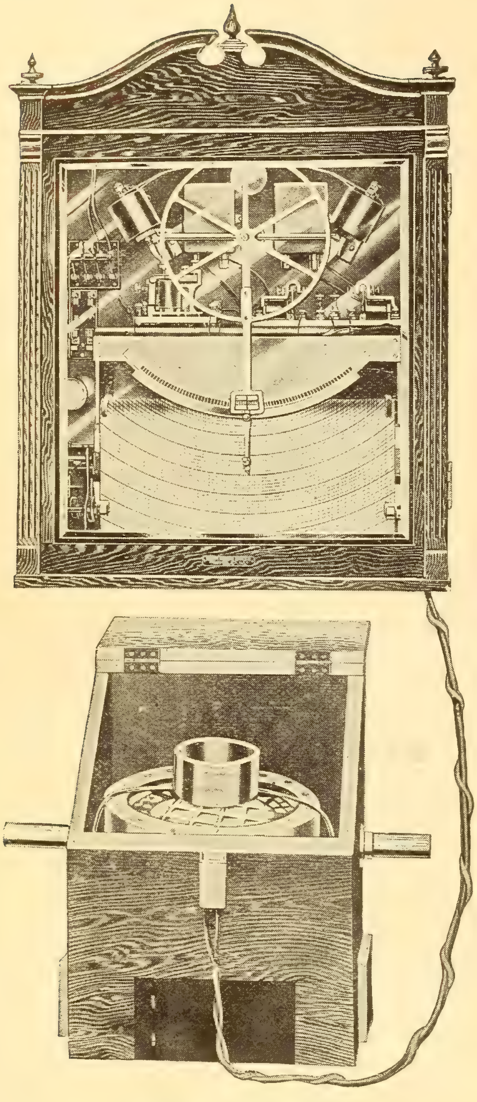
Through the agency of delicate contacts on a compass and the communication of the corresponding electric currents to a recording stylus controlled by two magnets, an electric recording compass has been perfected by a western inventor, which promises to become indispensable to the mariner. The compass proper makes the observations automatically and communicates them through two conductors to the recording mechanism enclosed in a cabinet in the pilot house or elsewhere. The device is so designated as to produce a continuous record of the direction of the ship with relation to time; so that the direction in which a ship was moving at any hour and minute can be determined at a glance at any time thereafter from an inspection of the records produced.

The instrument shows variations of about 2½ degrees or a trifle less than a quarter of a point, so that if a ship is on her course and the wheelman allows the vessel to wander as much as 2½ degrees off the course laid out the automatic mechanism will at once register the error permanently and the exact time that the deviation occurred, so that a captain by looking over the chart can discover at once whether his ship has been working to starboard or to port, and whether his instructions have been followed.

It is also possible to secure a definite idea of the conditions encountered at sea; in a seaway, or during rough weather the record will be irregular while during calm the course indicated by the appliance will be almost a smooth line. The size of the instrument is two feet square by ten inches deep and it can be connected to any ordinary lamp socket which will give a voltage of from 100 to 125 volts.

The only attention required is the placing of a new chart on the roll every month and filling the pen about every two weeks.

The clock movement which moves the chart in the recording mechanism allows it

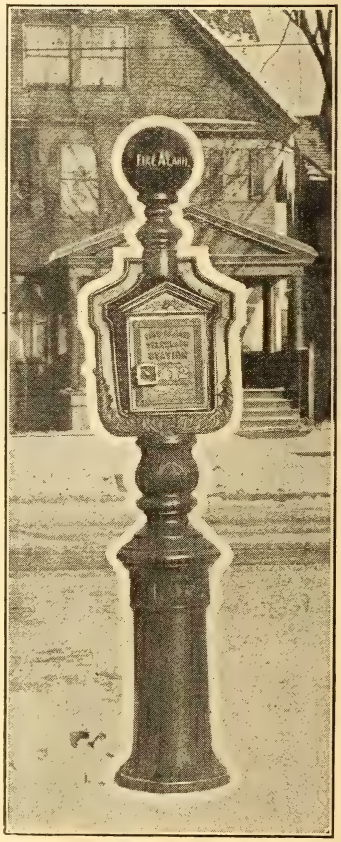


RECORDING COMPASS

to pass by the recording point 2½ inches every hour. The clock is wound by electricity automatically and requires no attention whatever. An ingenious feature of the instrument is the circuit changer, which automatically throws the instrument on a set of batteries if the dynamo current for any reason should give out, and again switches the dynamo current in when it is again in operation. Thus the continuity of the record is maintained, and the captain can tell by a glance at the sheet whether or not the man at the wheel has been attending to business.

Where is Your Fire Alarm Box Located?

Could you tell off-hand, if asked, right where to find the fire-alarm box nearest your house? In all probability you could not, for the average person does not bear in mind the obvious things which come to his attention every day. The city of Rochester, New York, has an infallible means of directing attention to it. Upon the top of each box as in the picture is placed a red glass globe bearing the words "Fire Alarm" in large white letters. Within the globe is an incandescent lamp the wires to which run under ground. In this way 300 boxes are pointed out. This innovation was the result of a recent fire in the city in which the man who discovered the blaze at night rushed about for some time in bewilderment trying to find a fire-alarm box.



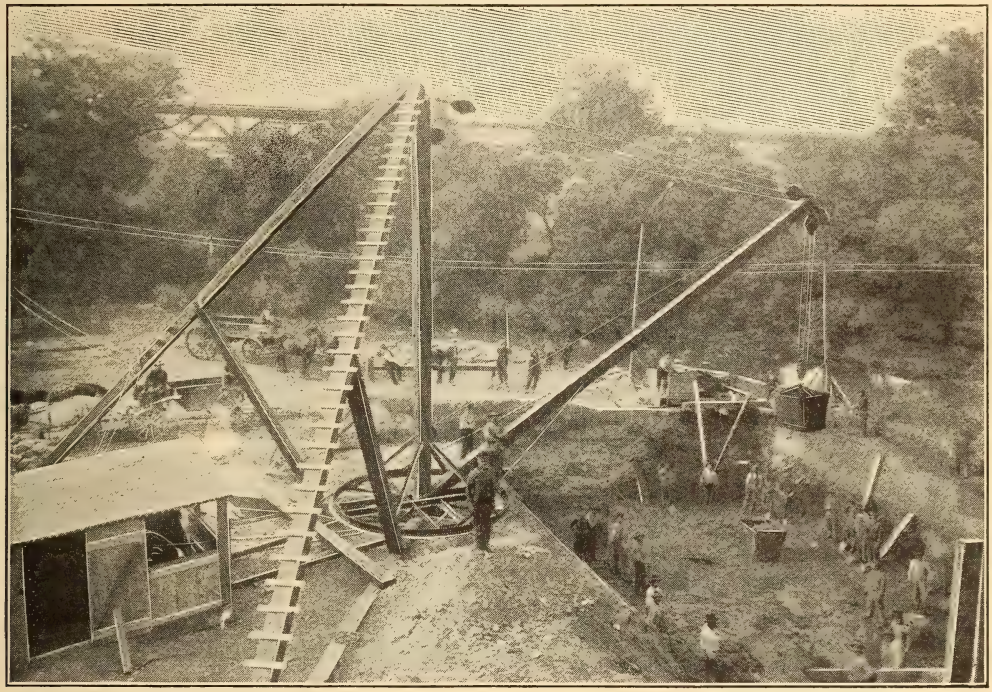
FIRE-ALARM BOX WITH LAMP INDICATOR

A Convertible Electric Derrick

It is of interest to note that, in the use of electric derricks on excavation and construction work, either the guy type or the stiff leg type of derrick may be used, as best adapted to local conditions. The electric derrick shown in the accompanying illustration was specially designed to be convertible into either type, as required. This is affected by the use of special interchangeable fittings, so that only a small number of extra parts is required to change the derrick for different classes of work. The machine can be adapted for use in excavating as well as for handling material. Two lines are led over the boom for operating the grab bucket. The line for the topping lift, which raises and lowers the boom, is led up to the head of the mast and thence across to the head of the boom.

This design of electric derrick was utilized in the construction of the Grand Avenue reinforced-concrete viaduct at Milwaukee, Wisconsin. The hoisting capacity is six tons and the working radius is from twelve feet to 38 feet, while the vertical lift is about 30 feet.

It may be stated that this derrick is operated by an electric hoist of 20 horsepower. It has two drums, and on one end of the shaft is a special reversible winch for swinging the derrick. The other shaft carries an ordinary winch head besides the drum. In addition to the ordinary band brake, there is an automatic brake to prevent the drums from backing in the event of current being accidentally cut off while the machine is hoisting a load. The operating levers for the controller, the clutches and the brakes are arranged very much as in a steam hoist. The derrick is swung by means of a bull-wheel which is built of steel and is adaptable to derricks of various sizes.



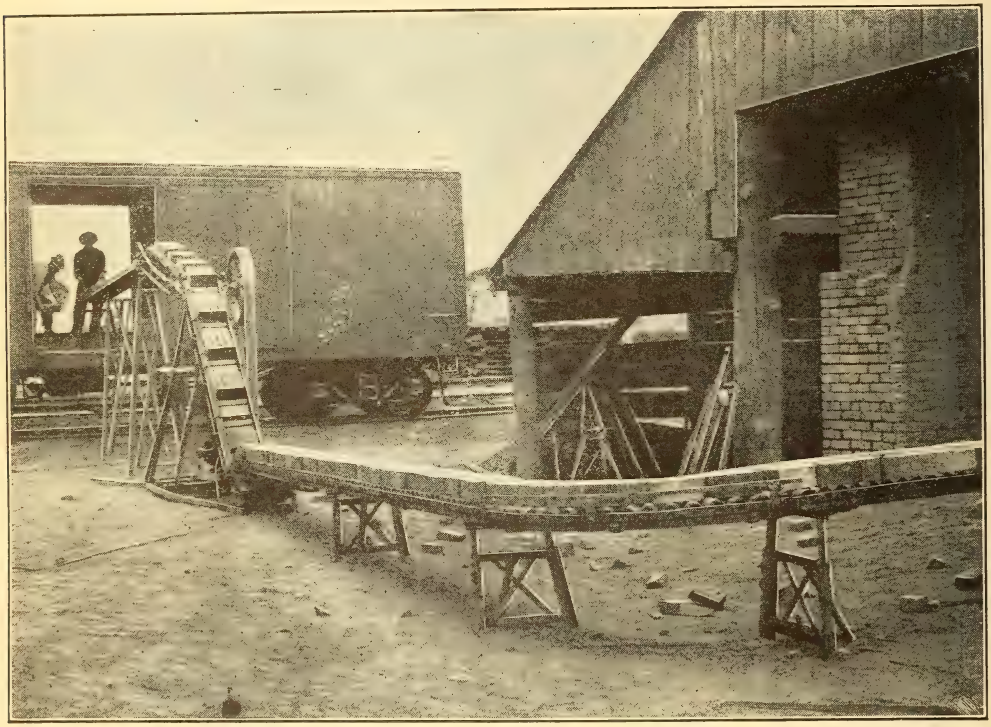
CONVERTIBLE ELECTRIC DERRICK

Tantalum Lamps for Car Lighting

By using tantalum lamps for car-lighting, the Chicago Railway Company finds that it can save five cents a day per car. A thousand cars have been equipped with tantalum lamps, and will save the company $18,000 a year on this basis. The company expects to equip all of its cars in this way, and effect a saving of over $35,000 a year.

Electricity and Gravity Do the Work

The portable electric elevator noted at work in the accompanying illustration is provided with an electric motor under the hoisting equipment connected with a flexible cable for supplying the current. This electric portable elevator is utilized in connection with a gravity carrier and is a very necessary device at this brick yard. By placing it near the loading point it receives automatically from the gravity carrier at the bottom and discharges automatically at the top to the gravity carrier above, from whence the bricks are conveyed any distance to the car and around curves if necessary. This machine automatically handles loose brick and keeps them together to their destination.



PORTABLE ELECTRIC CARRIER AND ELEVATOR

It may be stated that a decade ago little was known of the tremendous possibilities back of the idea of utilizing a natural force, such as gravity, as a means of conveying merchandise from point to point in and about factory plants. Today it is a recognized element in factory and warehouse economy; its development has been rapid and scientific. Practical men in all lines of manufacturing recognized its value the moment it was brought to their attention; recognized that its chief merits lay in economy of labor, and time, the two great essentials in profitable manufacturing.

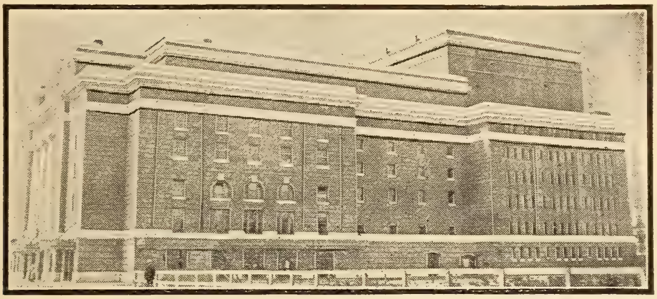
Ball bearings are used and modern gravity carriers and automatic elevators are constructed scientifically and accurately.

Queer Ocean Power Plant

During the fitting out of the White Star liner "Olympic," electrical energy for light and power was supplied from a tug moored alongside the larger vessel. This tug has an electrical plant with a capacity of 320 kilowatts on board, and was also fitted with a powerful steam fire pump. It is therefore both a floating electric generating station and fire station, in addition to being a tug. The "Jackal," as the tug is called, has engines of 1,500 horsepower. For the purpose of driving the electric plant the shafting connecting the propeller with the engine was uncoupled and the dynamos coupled up instead.

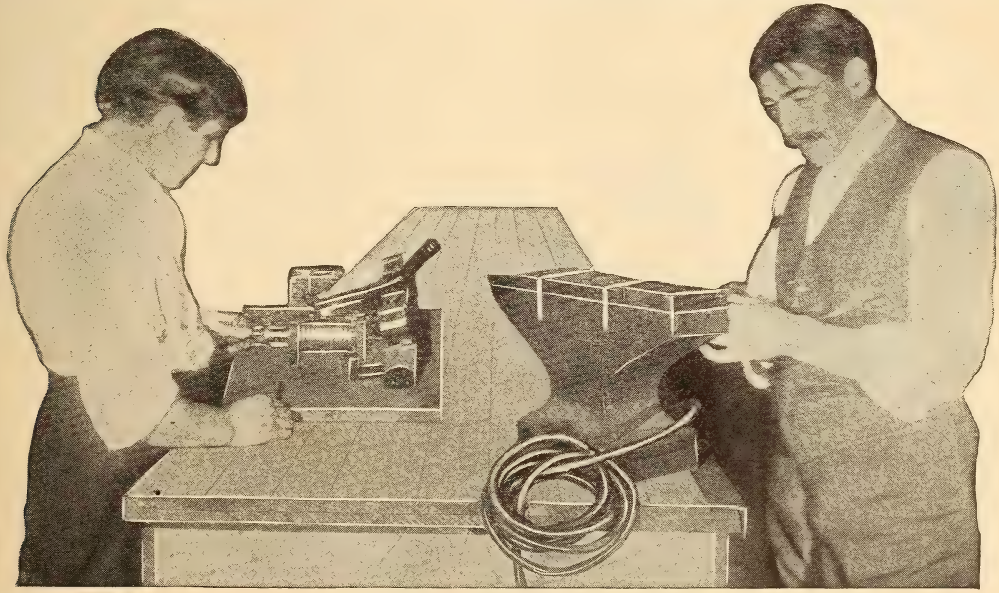
Producing a Grand Opera

There is one field of present-day activity where electricity has worked its miracles almost unknown to the general public. This is in the technical side of theatrical, and more especially grand opera productions. When one stops to consider for a moment, however, it is not altogether strange that the public should not realize the extent to which electricity has, in the last few years, revolutionized things "behind the scenes," for all that the public at large takes so lively an interest in all that goes on in the realm of music and the drama. Stage celebrities and musical stars are willing enough to take the public into their confidence regarding their own personalities but the shrewd business men and technical experts who provide the settings for operatic and dramatic entertainments are by no means so frank. They like to preserve the traditional air of mystery in which the stage has been more or less enshrouded from time out of mind, and they like to astonish their public by glowing spectacles and sensational lighting effects without disclosing to the people "out in front" how the beauties of such illumination are obtained.



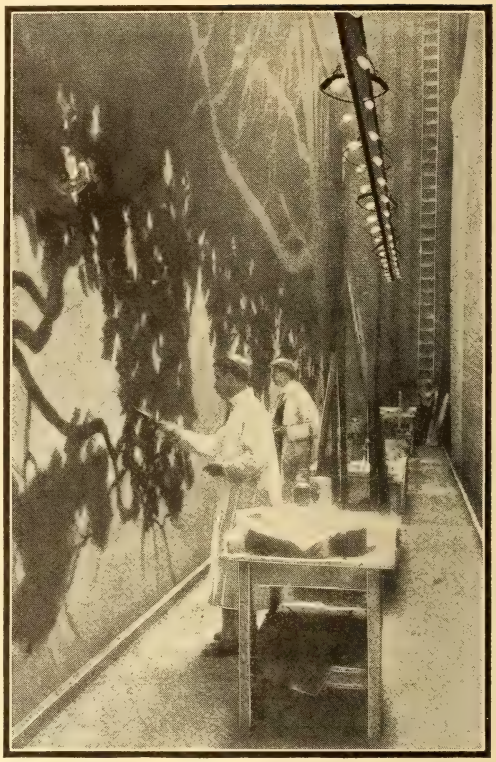
NEW HOME OF THE BOSTON GRAND OPERA

However, if you will corner the practical master of Twentieth Century stagecraft he



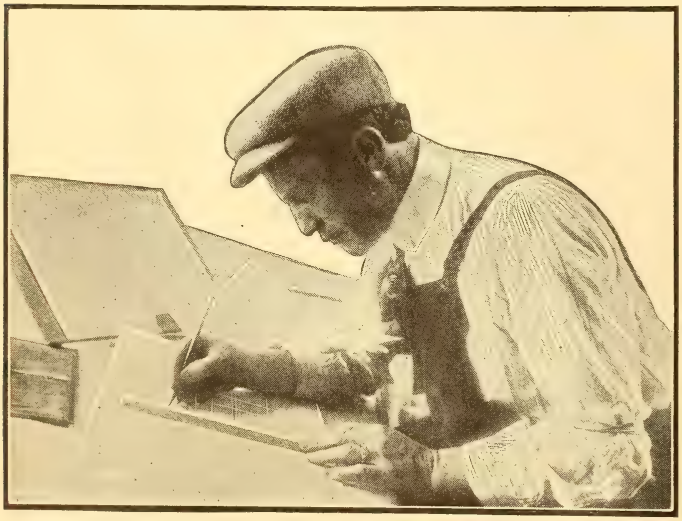
ELECTRICIANS AT WORK IN THE GRAND OPERA HOUSE—THE MAN AT THE RIGHT IS WIRING THE ELECTRIC "ANVIL" FOR USE IN THE "ANVIL CHORUS" IN "TROVATORE" will admit that no other one factor has been so influential as electricity in rendering possible the massive stage productions of the present age and more particularly their spectacular investure. Electricity has played its part in every branch of the entertainment field but naturally its fullest utilization has been found in grand opera—because on the one hand grand opera calls for not only elaborate but often mythical or fantastic counterfeit environment, while on the other hand the stage productions in grand opera are more extensive and more massive in every sense than in the ordinary drama.

Any layman must appreciate that the greatest service that electricity has rendered stage folk has been in illumination before and behind the footlights. It is difficult to cite a more striking transformation in any sphere of the world's work than the transition from the old days of oil lamps, slowly and laboriously extinguished when a "dark set" was required and "red fire" burned on a shovel when little Eva or Marguerite ascended to heaven, to the present facility with which an entire theatre may be plunged into darkness in the twinkling of an eye and all the tints of dawn, sunset and moonlight simulated by means of electric lights so skilfully varied in their intensity as to challenge Nature and convey to the spectators no hint of the mechanical to spoil the illusion.



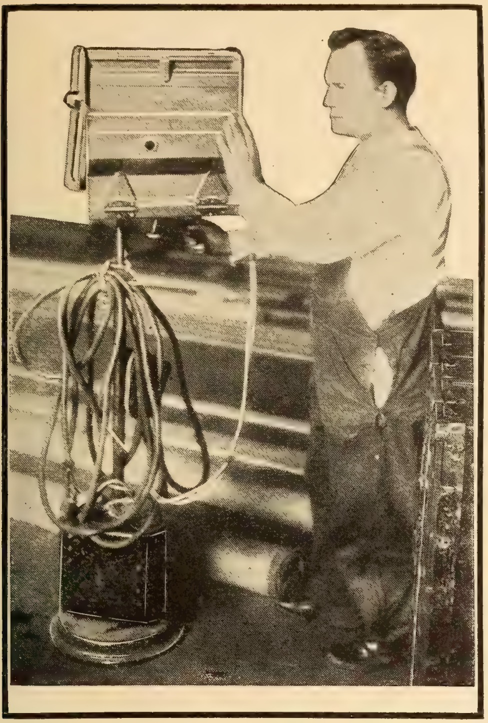
PAINTING SCENERY AT NIGHT BY ELECTRIC LIGHT

Some idea of the extent of the dependence placed upon electrical lighting at a modern temple of grand opera may be gained if you will take, by proxy, a peep at the electrical "nerve center" in the nether regions of darkness beneath the stage of the new Boston Grand Opera House—the model opera house of the world. Here, in a long narrow apartment just wide enough to allow two or three electricians to work, is located what is claimed to be the finest switchboard of the kind in the world. It cost $26,000 and it controls stage illuminants aggregating 5,000 incandescents and 50 arcs.



PLANNING THE LAY-OUT OF ELECTRIC LIGHTS FOR THE VARIOUS SCENES OF AN OPERA

Many unusual features impress one in the equipment of this subterranean seat of electrical energy. For one thing there is a seeming excess of facili-

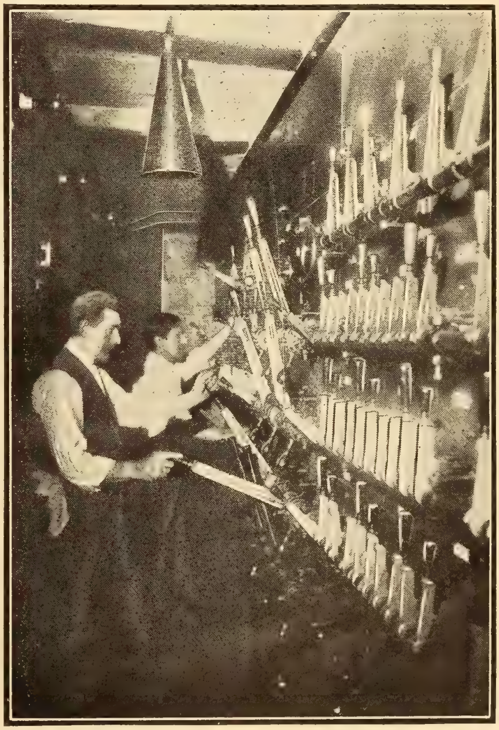


ELECTRIC SPOT LIGHT

ties for the transmission from the stage, quickly and accurately, of orders for the electricians operating the switches in the pit. This precaution is understandable however, when it is remembered that a moment's delay in switching on or off the lights may mar a "scene." Ordinarily electric bells are depended upon to transmit signals but there are also speaking tubes and finally, directly above the head of the chief electrician is a megaphone through which the stage manager in the wings overhead may shout an emergency order.

The duties of the electricians stationed before this switchboard while a production of grand opera is in progress are complicated by the fact that aside from the necessity for quick action at all times there is the circumstance that systems of lamps in a number of different colors must be controlled. For instance, the footlights and the border lights comprise not merely single rows of incandescent lamps but lines of different colored bulbs ranged side by side—red or pink to simulate dawn; yellow for sunlight; blue for moonlight, etc. In order to simplify the manipulation of these colored lights the levers of the switches on the big board are painted in colors corresponding to the tints of the respective systems of lamps which they control. Yet another requisite of skill that confronts the men who throw the switches "below stage" is the frequent necessity for delicate manipulation in the handling of the lights. Rosy dawn must give way by the most gradual flow of light to the full glare of day, or a brilliant sunset must fade into twilight and thence to the mellow radiance of moonlight. Modern electrical science has supplied the big switchboard with all known electrical aids to such kaleidoscopic work, called "dimmers," but after all much depends on the skill and judgment of the men in front of the switch board.

The switchboard work, important as it is, is but one phase of the illuminating responsibilities incident to a grand opera production. On the stage, on specially constructed platforms elevated somewhat above the heads of the singers, maybe even in the "flies" far overhead and out in the midst of the audience in gallery or balcony, other electricians are manipulating "spot lights" and the electrical



SWITCHBOARD OF THE NEW BOSTON GRAND OPERA HOUSE, BUILT AT A COST OF $26,000 successors of the once-familiar but now obsolete calcium light. These powerful lights designed for projection in one given direction are almost invariably arcs and the common form is that of a lamp with a strong reflector mounted upon an iron standard which is in turn rigidly supported by a heavy iron pedestal. The manipulation of these lights involves something more than the mere switching off and on at the proper moments and the ticklish task of keeping the beams centered on a "star" who will resent as a personal insult anything suggestive of a shadow. In addition there is the necessity for helping to carry out any "color scheme," such as has been mentioned in speaking of the incandescents controlled solely from the main switchboard. Only in the case of the spot lights, etc., the tintings of the scene on the stage are accomplished by means of color screens held before each arc. Or if a quick succession of rainbow tints is desired, as in the illumination of a dance, the electrician revolves before his spot light a wheel made up of panels or broad spokes of different colored glasses or other tinting mediums.

A perfectly equipped and very spacious electrical supply storehouse and workshop is an adjunct nowadays of every up-to-date grand opera house. This is the headquarters of the chief electrician and anywhere from three to a dozen assistants—dependent somewhat upon the class of productions being staged. The storehouse feature is important because an opera house must keep on hand at all times a plentiful surplus of all standard classes of supplies. There is no time to "send out and get it" when a grand opera is on. It must needs be a pretty capacious storeroom too, and well systematized because of the wide range of material required. For instance, almost as much space must be given over to red globes and blue globes and yellow lamps respectively, as is accorded the ordinary ones of clear glass. And there are no end of electrical "properties" that may be needed only once or twice a year, but must be kept ready to hand,—for instance the anvils for "Trovatore" that give forth electrical sparks when they are struck in accompaniment to the singing of the "Anvil Chorus," and the swords of Faust and Valentine and Mephisto that strike mysterious fire in the great duel scene of "Faust."

While present-day dependence upon electricity for scenic and lighting effects in modern operatic production is perhaps paramount it constitutes only one of a long list of duties entrusted to the current in the Twentieth Century home of grand opera. "Call boys" have virtually been done away with because electric bells and flashing electric lights signal "Overture," "Fifteen Minutes," "Second Act," and all the other staple summons of stagedom to every participant from the prima donna to the most humble chorus man and to the members of the orchestra as well. A complete telephone system connects every part of the realm behind the curtain. And on the scene painting bridges, in the property room and the wardrobe departments there are elaborate lighting sytsems that enable "rush work" at night in an emergency. The elevators for singers and scenery are electrically operated and so are the "traps" which facilitate descent below the level of the stage in certain productions. In the up-to-date opera house electricity is even employed to operate the drop curtain and the art of facial "make-up" has been greatly simplified because the stage artist may now surround his dressing room mirror with a row of electric bulbs thereby securing an illumination for his delicate decorative work that was scarcely possible in the old days of gas jets and which, if it had been practicable, would have made intolerable the temperature of the average tiny dressing room.

ELECTRIC CURRENT AT WORK

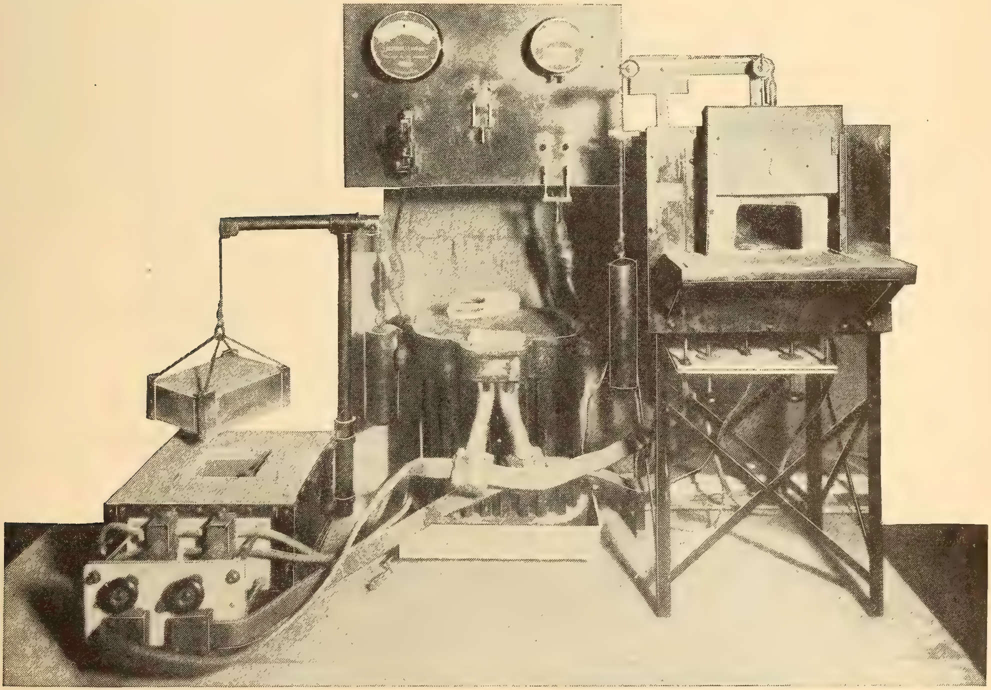
NEW DEVICES FOR APPLYING ELECTRICITY

New Ideas from the Chicago Electrical Show

Furnaces for Assayers and Toolmakers

The electric arc is known to be the hottest place on earth, but it is surprising to learn that electric furnaces of the resistance type can be brought up to a temperature as high as 3,000° F. The two furnaces shown in the picture are of the Hoskins type. The one at the left is of the crucible type used by assayers. On the other side is a furnace used for tempering "high speed" steel intended for rapid cutting lathes. The crucible furnace develops in the little white hot pit a temperature of some 2,300° F. When the materials to be melted are placed in the pit, and the cover swung over them by the little hand derrick, they melt like wax unless they are composed of some extremely refractory substance like carbon.

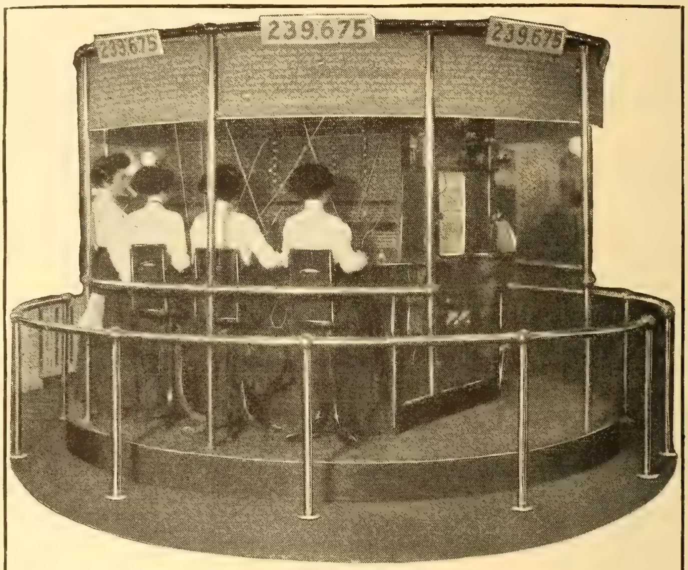
In the middle of the picture is the transformer which changes the current to a voltage and volume suitable for the furnaces. This current is carried through the massive flat conductors shown in the foreground to the terminals of the furnace. Imbedded in the thick, heat-resisting walls of the furnace are carbon resistance rods. When the current flows through these rods from the terminals they are heated to a white heat and the interior of the pit becomes so dazzling in its brilliancy as almost to rival the sun itself.



ELECTRIC FURNACES FOR ASSAYERS AND TOOL MAKERS

How Telephone Calls Are Handled

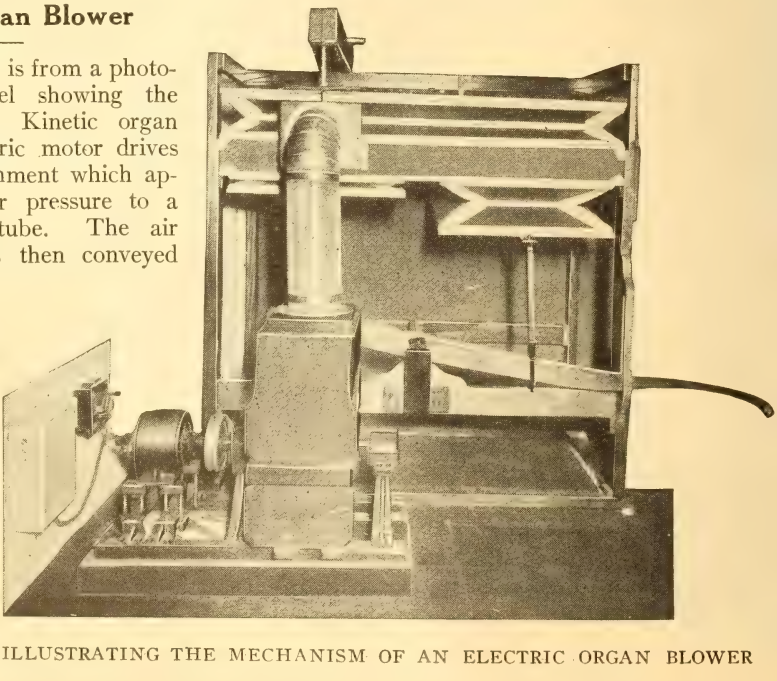
Something of the discipline and strict attention to business which must pervade a large telephone exchange in order that subscribers may be promptly taken care of was enacted in the Chicago Telephone Company exhibit at the Electrical Show. A revolving platform carried telephone switchboard panels at which were seated six operators under two supervisors. Although no outside connections were served, "call" and "supervising" lamps were flashed automatically by mechanism back of the panels, requiring the operators to perform the same duties as are necessary when working in an exchange. The supervisor shown standing back of the operators assists in adjusting complaints and helping wherever necessary, leaving the operators free to attend to calls. Near this exhibit were long distance telephone booths into which one might step and find out how it seems to talk with St. Louis, Cincinnati or New York.



REVOLVING TELEPHONE SWITCHBOARD

Kinetic Organ Blower

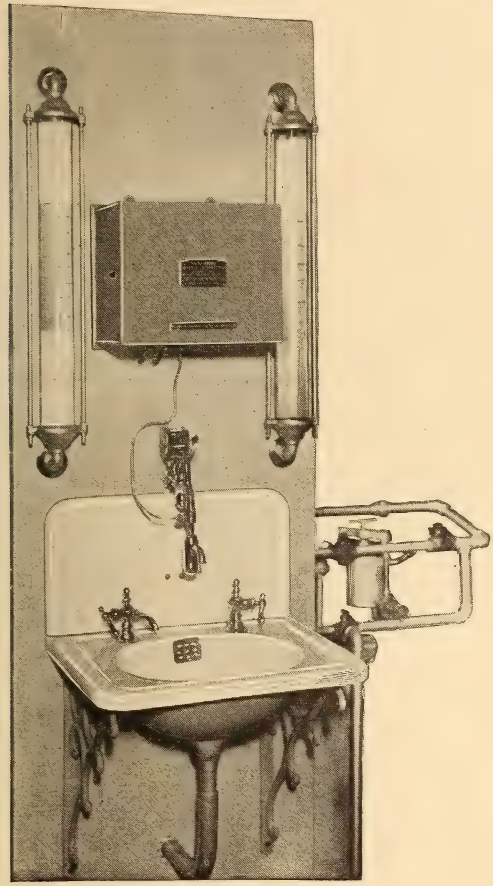
This illustration is from a photograph of a model showing the operation of the Kinetic organ blower. An electric motor drives the blowing attachment which applies a steady air pressure to a galvanized iron tube. The air under pressure, is then conveyed to a bellows which in that case acts as a sort of storage reservoir giving practically uniform pressure for delivery to the reeds. The ample and steady air supply is said to give the organist a sense of security which is thoroughly satisfying.



ILLUSTRATING THE MECHANISM OF AN ELECTRIC ORGAN BLOWER

Purifying Water with Ozone

The Ozosure water sterilizer delivers pure drinking water instantly by simply opening the faucet. This operation closes a switch which turns current from any ordinary lighting circuit into the metal box above the wash bowl. Within this box the current is so changed as to jump across, in the form of electric sparks, between hundreds of needle points. These little sparks take oxygen from the air and unite three atoms of it into a molecule of ozone. But one of the atoms in the ozone molecule is always trying to get away and combine with carbon material, which forms the greater part of all microbes, consequently when the faucet is turned on and the suction draws ozone down the metal pipe from the ozone box into the mixing bulb just back of the faucet the ozone warriors literally burn up the germs and impurities.



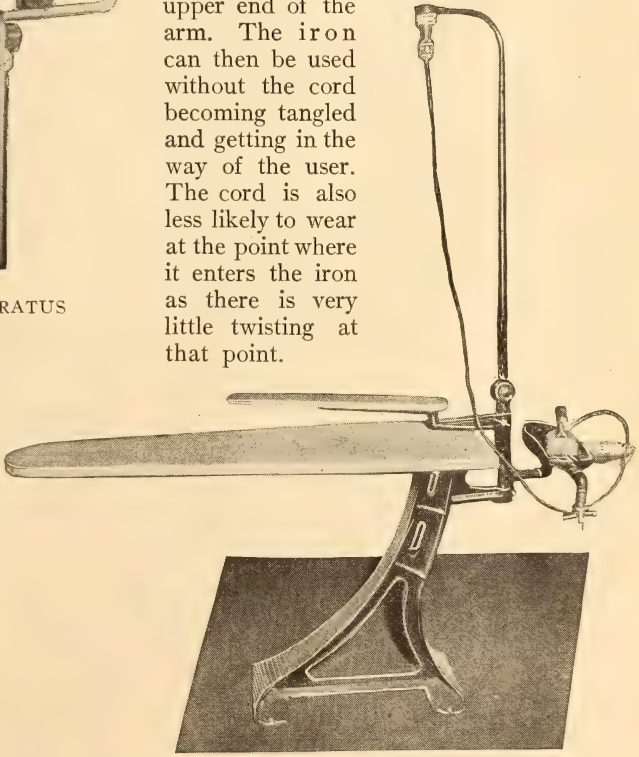
WATER OZONIZING APPARATUS

The Mailometer

The mailometer as it is called is one of the latest electrically driven office appliances. It will seal, stamp and count 150 letters a minute and is a positive check on your postage stamp account, the specially made stamps being locked in a case and automatically recorded as they pass upon the envelopes.

Ironing Board and Cord Support

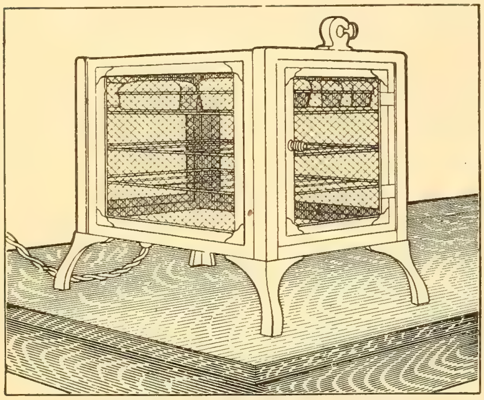
Could anything be more convenient than this ironing board with its two parts adapted for large work or sleeves and collars? At the right is a little shelf for the electric iron. A vertical arm projects well up above the board, and the cord which supplies current to the iron is attached to the receptacle in the upper end of the arm. The iron can then be used without the cord becoming tangled and getting in the way of the user. The cord is also less likely to wear at the point where it enters the iron as there is very little twisting at that point.



IRONING BOARD AND CORD SUPPORT

Watching it Bake

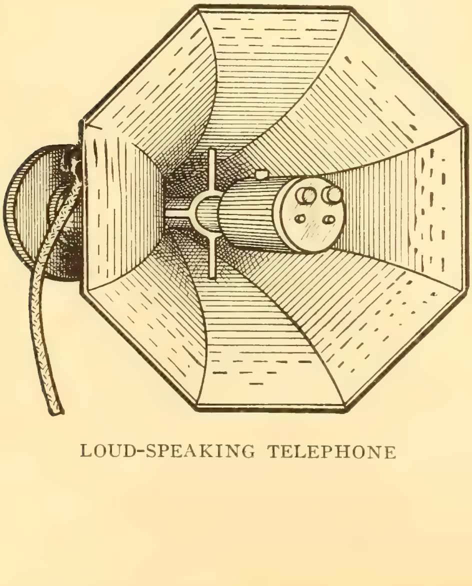
An oven with sides of wire glass enabled hundreds of Show visitors to witness the baking of bread by electricity. Placing eight small loaves on each shelf, in about 20 minutes the top of every loaf showed the baking complete by being done to a nice rich brown. Large loaves required about 30 minutes. In the same exhibit with the Simplex glass oven a larger metal inclosed oven turned out 80 one-pound loaves at one baking which were given to charity. This oven was heated electrically to a temperature of about 350° F.



A GLASS OVEN

A Loud-Speaking Telephone

To speak into one transmitter and have the speaker's words conveyed to a distance and distinctly pronounced to any number of people is a possibility practically demonstrated by the Automatic Enunciator.



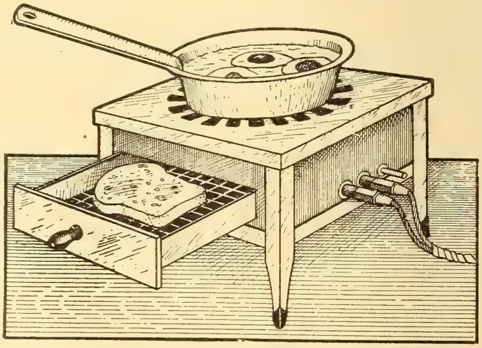
LOUD-SPEAKING TELEPHONE

A telegram, we will suppose, arrives at the Coliseum for Mr. William Smith, while he is standing in the crowd within ordinary speaking distance of the enunciator. "A telegram at the information bureau for Mr. William Smith," calls out the enunciator, the funnel-shaped device illustrated, of which there are several distributed about on the wall or on convenient pillars. Mr. Smith hears the words as plainly as if a man were shouting the information, and he goes up and gets his telegram.

The enunciator may be used in hotels, clubs, factories, convention halls, theaters and in fact any place where it is necessary for one person to talk to a number of people in different locations at the same time. By installing the system in a hotel and providing enunciators for each floor the clerk will be able to find a guest if in the building by talking into a master transmitter at his desk, thus doing away with the paging system which is annoying and takes time.

Does Two Things at Once

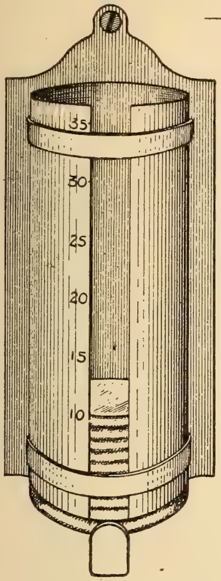
With the Cadillac combination stove and toaster you can prepare breakfast right on the dining table, for while you are cooking the eggs or chops or preparing the coffee on the top of the stove you may be making toast in the little drawer beneath the red hot coil of the grid. After the meal is ready, keep the coffee warm by switching to a lower temperature contact, there being three different heats provided for. The stove is



COMBINATION STOVE AND TOASTER

finished in black enamel and polished nickel and with it you can prepare a quick hot breakfast without starting the kitchen fire.

Telephone Slug Holder

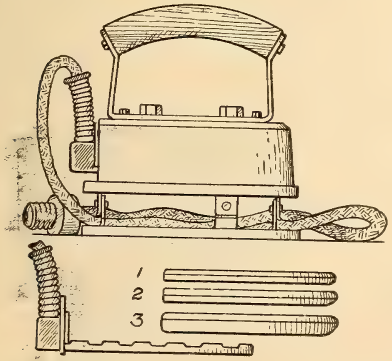


TELEPHONE SLUG HOLDER

When the telephone man calls you can tell him at once how many slugs are in the box if you use a Feurstein slug holder. Place 35 slugs in the holder at the beginning of the month and a glance at the scale on the outside at any time informs you how many remain. By pulling out a spring slide at the bottom one slug at a time is removed from the device. The holder is of polished sheet metal, a back containing screw holes serving for mounting near the telephone.

Three in One

Every housewife appreciates having a pressing iron suited in weight to the garment or cloth being pressed out, and for this reason two or three irons of different weights are often a part of the laundry equipment.

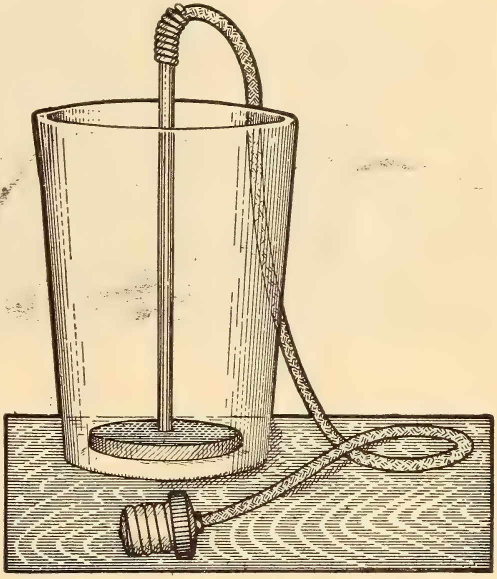


FLAT IRON WITH THREE WEIGHTS

The Van electric iron, however, is designed to make it serviceable in all capacities. It is so constructed as to be operated as any one of three irons of different weights. By removing the two top screws on the rear of the iron, then loosening the two bolts at the base of the handles the heater and connection may be pulled out and weights No. 1, 2 or 3, placed on the heater making either a five, six, or seven pound iron. Another special feature is the suiting of the iron to various voltages ranging from 100 to 125 volts by changing heaters in the same manner as the weight of the iron is varied.

Boiling Water in a Glass

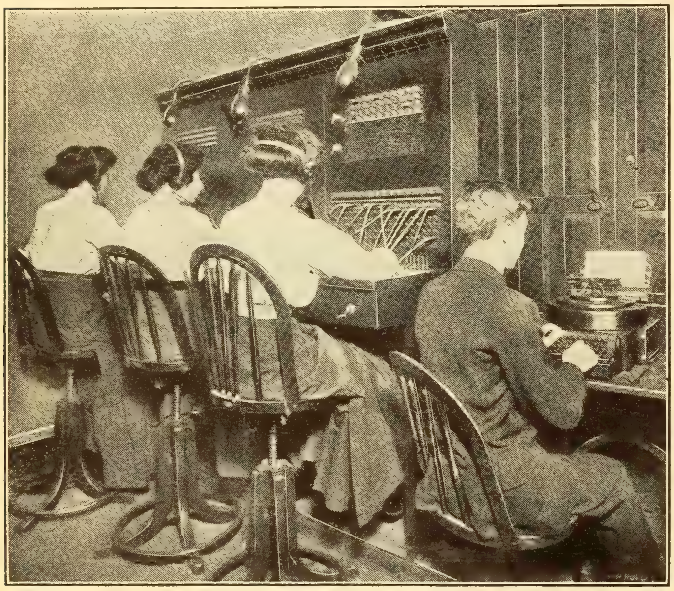
To get a glass of boiling water in a minute's time is very easily accomplished with the little device shown in the drawing. Inside the disk is an electric heating element to which current is conducted through insulated wires running down through the stem. As the current flows through the concealed wires of the heating element the disk is at once brought to a temperature sufficiently high to boil the water in a very short time. This is a very convenient device for travelers, dentists and physicians.



DEVICE TO BOIL A GLASS OF WATER

According to statistics quoted in *Engineering*, there are in the whole world 9,600,000 telephones, and the lines have an aggregate length of about 12,500,000 miles.

A Telegraph Typewriter



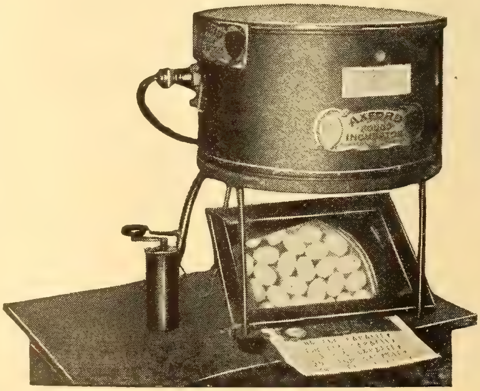
THE TELEGRAPH TYPEWRITER AT THE RIGHT IS SENDING MESSAGES OVER TELEPHONE LINES WHILE CONVERSATIONS ARE TAKING PLACE SIMULTANEOUSLY

It is now possible to send a typewritten message hundreds of miles across the country and this latest triumph in the transmission of intelligence was on exhibition at the Electrical Show. It is the invention of Dr. G. A. Cardwell and does not look very much different from the ordinary typewriter. When the operator wishes to send a message he pounds it off on a keyboard like the ordinary typewriter keyboard. The act of depressing the keys sends out over the telegraph line (or even over a telephone line which is at the same time carrying telephonic messages) a series of electrical impulses. These impulses when they arrive at the receiving station operate a system of electromagnetic relays which shift a little wheel carrying raised type around so as to print each letter the instant the impulses are received. It works upon the "selected" system, each letter of the transmitting instrument sending a certain series of impulses which automatically select and print the corresponding letter at the receiving machine.

In the picture is shown a telephone switchboard of the Bell Telephone Company, in the office of the Long Island Railroad. At the right in the picture is one of the "American" telegraph typewriters actually sending a typewritten message over the same wires that enter the switchboard and which are at the same time being used for telephonic purposes.

Electric Incubator

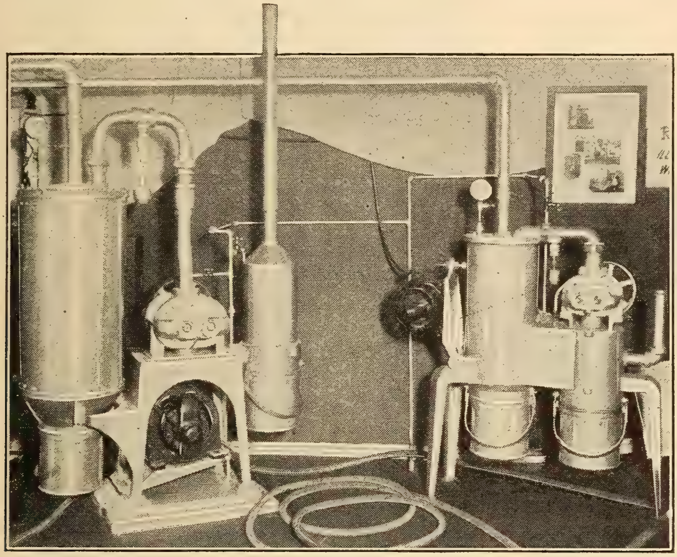
Resembling a large cheese enclosed in heat resisting material covered with leather, and mounted on legs with a mirror below to show the eggs on the glass bottom, the Axford, round, incubator exhibit attracted much attention. An incandescent lamp within furnishes the necessary heat, flashing on and off with the variation of temperature. A coiled spring thermostat like the one mounted on the dry cell on the table opens the lamp circuit when the temperature rises too high and closes it again when the heat falls below the point at which it is to remain practically constant. On account of this automatic feature the incubator needs no attention once current is turned on.



ELECTRIC INCUBATOR

Sends Dust and Dirt to the Basement

With the Houston system of cleaning, the maid takes a small roll of rubber hose, attaches one end to a wall coupling and the other to a light aluminum floor sweeper or other tool. Turning a switch she starts the machinery which is located in the basement, and the sweeping, cleaning and dusting begin all at the same time. By means of the special tools which may be attached to the hose, dirt and dust are sucked up from the floor, removed from the corners, picked up from off moulding and picture frames and started on a journey down a metal pipe to the basement to be deposited in a sealed metallic dirt receptacle of the vacuum cleaner. Pipes from the machine, which is operated by a motor-driven suction pump, lead to various floors where at convenient places small ornamental pipe couplings are located.



MOTOR AND VACUUM PUMPS LOCATED IN THE BASEMENT

The illustration shows two equipments; one for installation in cottages and small dwellings, the other for larger buildings.

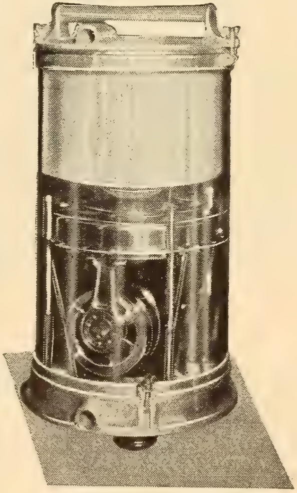
With this outfit, which may be installed in either old or new houses, the "broom and duster" method is rendered obsolete, and in addition the system insures the fact that the air which carried the germs, dust, dirt, etc., away is not again released in the room.

All Metal Washing Machine

The Apex—a washing machine entirely of metal except the wringer board—has a body somewhat cylindrical in shape on the outside but tapering at the top. It is constructed of galvanized sheeting and suspended at the ends on a steel frame so as to be easily rocked back and forth. On each side of the interior are four metal ribs which turn the clothes as the rocking causes them to fall from one side to the other of the enclosure. The bottom of the tub has on the inside also an inverted V, running lengthwise which helps in cleansing the clothes as they fall to the bottom. A small electric motor mounted underneath out of the way is geared to rock the tub. Adjusting a key connects the wringer to the motor and locks the tub in an upright position for running the clothes through the wringer which is mounted directly above the tub.

Vacuum Cleaner in a Glass House

The accompanying picture will give an idea of what the inside of a vacuum cleaner looks like—that is, one type, known as the Santo. This model is made for demonstration purposes, with glass sides instead of the usual metal case. Inside you can see the little motor which drives the diaphragm which in turn exhausts the air through a tube. The dust bag is

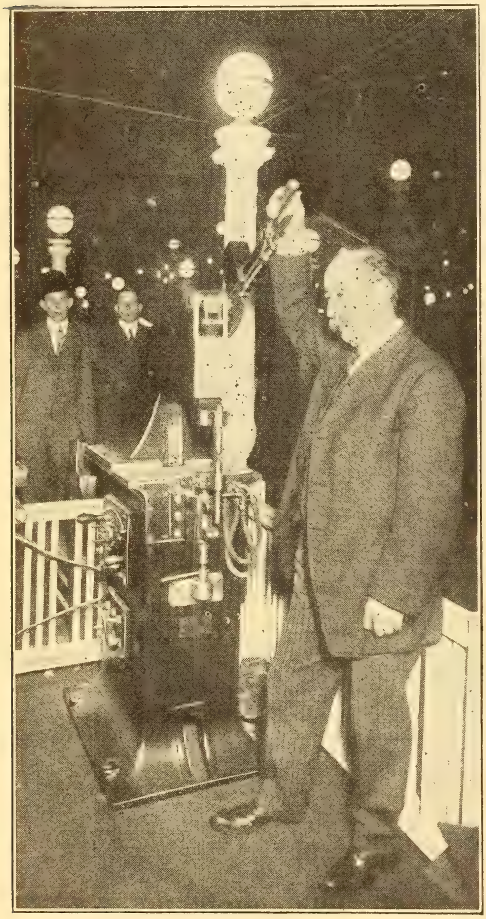


VACUUM CLEANER ENCLOSED IN GLASS

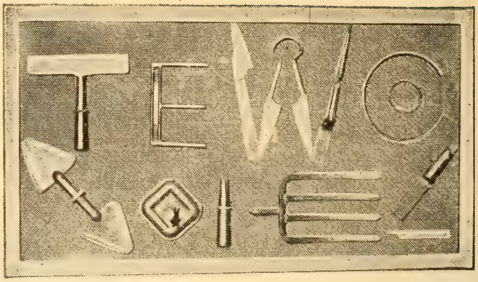
also contained inside of the cleaner case. This little machine, which runs without noise or vibration, operates from any electric light socket at a cost of less than two cents per hour for current.

"Riveting" Without Rivets

They call it "spot welding." The machine is shown with the lever up and the two copper pins, which serve for electrodes or dies, separated. Take two pieces of sheet metal, heavy or light, lay one across the other on the lower die. Pulling the lever arm down forces the upper die down until the metal is clamped between the upper and lower dies. Throwing the switch, there is a flash and the two pieces are welded. It seems to have been done by lightning in a condensed form.



ELECTRIC "RIVETER"



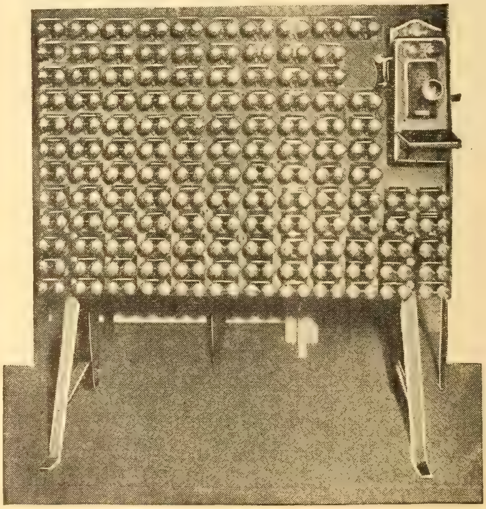
SAMPLES OF ELECTRIC WELDING

The metals are fused at a "spot" the size of a rivet and the time required to punch holes and insert rivets has been saved.

To the average man welding a bar of iron brings up visions of a dirty and grimy blacksmith shop with a leather-aproned, sooty-faced, sweaty and muscular individual swinging a sledge hammer and making a lot of noise on an anvil. But welding by electricity is more practical. The second illustration shows some of the products of electric welding.

A Modern Hercules

This unusual exhibit was for demonstrating the power of a telephone generator. It shows 258 gongs or 129 ringers, connected in series and all operated at once by the Hercules generator in the telephone set on the corner of the board. The gongs are so carefully toned that no discordant note is heard as 129 hammers vibrate in unison with but a slight turn of the generator crank.



ONE GENERATOR RINGS 258 GONGS

A Portable Stand Heater

An electric hot plate mounted on a neat, portable stand is one of the Hughes ideas. This is intended more particularly for hotels, restaurants and similar places where it can be brought right into the dining-room and placed beside a table. It permits of the preparation of many dishes usually prepared in a chafing dish. Like the Hughes stoves and hot plates, it embodies the most simple principle, that of a number of long coils of resistance wire laid in narrow slots or depressions in the composition plate forming the top of the stand. These wires are brought to a bright red glow by the current and the heat is all transmitted to the bottom of the cooking utensil.

PORTABLE STAND HEATER

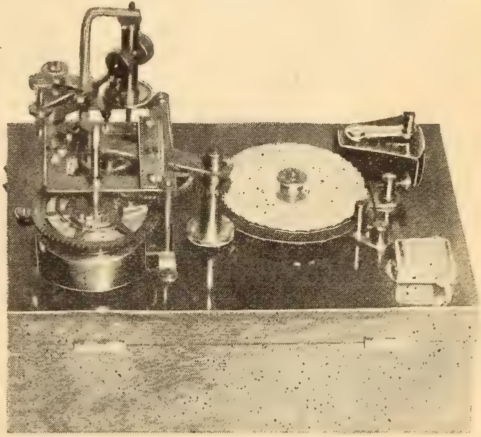
Keeps Tab on the Chimney

The cry is for clean cities, and to attain this it is necessary to suppress the smoke nuisance. Fulfilling the old saying, "Necessity is the mother of invention," the Hamler-Eddy smoke recorder tells the condition every hour in the day of the gases that go up the chimney in a steam plant. The recorder consists of a sheet of paper on a cylinder operated by a clock, a small nozzle with its end very close to the paper, a little motor driven pump and some glass globes and tubes containing chemicals for removing moisture from the stack gases tested.

In operation the pump sucks in gases from the chimney, which after being freed from moisture are forced in little puffs against the paper as it moves by at a steady rate, thus allowing the carbon to be deposited in the form of a black line upon it. Every hour the cylinder drops a notch and another line is started. If little smoke is going up the chimney the paper is clean, growing darker as the smoke increases. The recorder may be installed right in the boiler room, the enclosure being of glass.

Wireless Telegraph Instructor

Every wireless operator who passed the Swedish-American exhibit at the Coliseum paused to take a message, for a sound very much like the dots and dashes heard in his head phones fell upon his ears. It was not a message of distress, but taken down read, "John quickly temporized five tow bags," a sentence containing every letter in the alphabet except "x".

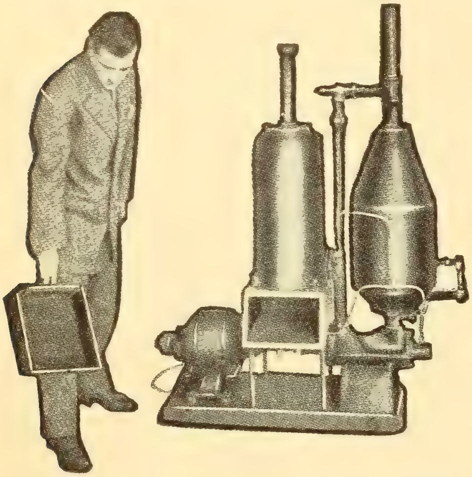


WIRELESS TELEGRAPH INSTRUCTOR

The device consists of clockwork which revolves a brass disk $3\frac{1}{2}$ inches in diameter, on the edges of which are projecting teeth shaped to sound the dots and dashes indicating different letters of the Morse code on a small buzzer. These teeth touch a contactor that closes a circuit through the buzzer and two dry cells within the case. Disks containing other sentences may be put on just as with a phonograph. The outfit is mounted on and within a neat quarter sawed oak box about 6 by 10 by $3\frac{1}{2}$ inches.

Stationary Vacuum Cleaning System

In the case of the Richmond vacuum cleaning system we have a permanent plant to be installed in the basement of a home, the same as a hot water or steam heating plant, with a piping system running up to the various rooms. Inlets to the piping are located in each room to which a hose and cleaning nozzle are connected. The motor shown in the picture operates a suction pump and the dirt and dust are drawn down through the pipes into a receptacle in the machine. When through cleaning you simply pull out a drawer and dump the dirt the same as you would ashes from a furnace.



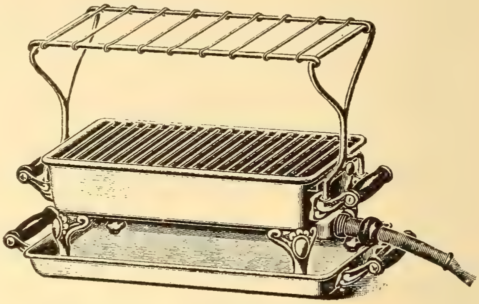
STATIONARY VACUUM CLEANING SYSTEM

Illuminated Prismatic Glass Signs

A departure from the usual exposed lamp sign is furnished by the Flexflume glass letter sign in which the lamps and reflectors are behind the letters and within the sign. The letters are prismatic glass moulded into shape and stand out in bold relief against a black metal background. Effective in daylight, the letters are very sharp and clearly defined at night. The small number of lamps needed, ordinarily averaging one for each letter make the sign economical of current.

Combined Stove and Toaster

An entirely new principle in applying electric heat is embodied in the Pelouze toaster and griddle. It is called the "radiant suspension" system. Insulators or other bodies of matter which absorb heat are eliminated in the construction of the stove, which will toast the first slice of bread in 50 seconds and the second in 45 seconds. The little wire rack above the heating element may be used for keeping the toast hot or as a plate warmer.



COMBINED STOVE AND TOASTER

The Tom Thumb of Vacuum Cleaners

A ten-pound suction cleaner is one of the new comers in the field of household electric appliances. The Magic cleaner is made entirely of metal being enclosed in a strong steel and aluminum case and is mounted on two small rubber-tired wheels. The exterior is nickel-plated and polished. By removing the dust bag and attaching a special connector the machine may be used as a blower. The usual attachments are provided for the equipment.

A TEN-POUND VACUUM CLEANER

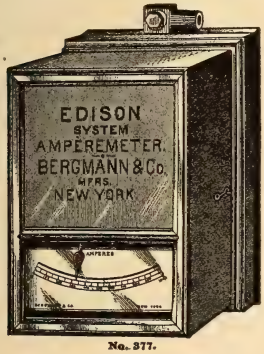
FOR PRACTICAL ELECTRICAL WORKERS

HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

Some Historical Measuring Instruments

By W. S. ANDREWS

A three-wire Edison central station with overhead system of distribution was installed in Cumberland, Md., in 1885, and the new incandescent light was so well appreciated by the citizens there that in 1887 four more dynamos were added, thus enlarging the plant to a capacity of six dynamos, three being connected in multiple on each side of the three-wire system. The steam plant was also at the same time correspondingly increased and improved.

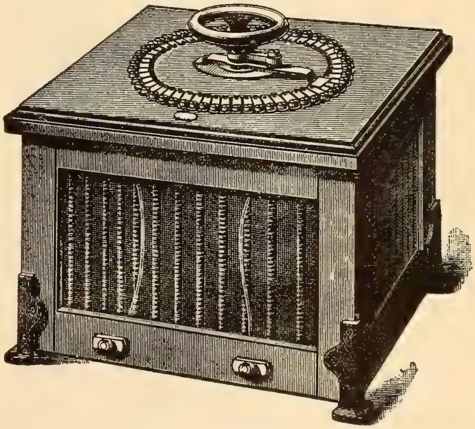


PENDULUM AMPERE METER

Soon after these additions had been made, a series of troubles were reported to the New York office of the Edison Electric Light company, principally referring to the burning out of dynamo armatures, so Mr. Edison requested the writer to visit Cumberland and make a careful inspection of the electrical plant.

The Cumberland Electric Lighting Station was found in the charge of a very intelligent colored man, and on questioning him as to his method of distributing the load among the three dynamos, connected in multiple, he replied that he had been told that the passage of electricity through a wire caused it to warm up, and "*the heavier the current the hotter the wire.*" He therefore went around occasionally and *felt* the copper leads running from the dynamos to the bus bars and if one of them seemed a little warmer than the others to the touch he would reduce the load on this machine by turning some extra resistance into its field rheostat! Under working conditions such as these who could blame the man if an overloaded armature was occasionally burnt out? On learning the above facts Mr. Edison promptly decided that when two or more dynamos were connected to run in multiple, it was highly desirable to use a current indicator in series with each machine.

No suitable instruments of this kind being on the market at that time, it became necessary to design and make them and Mr. Edison insisted that they must be simple and rugged in construction, cheap to manufacture, and easy to repair.



"FIELD REGULATOR"

The old "pendulum ampere-meter", jointly invented by Mr. Montgomery Waddell and the writer, and subsequently improved by Mr. Charles Wirt, was the result of Mr. Edison's decision, and this form of ammeter performed good service for many years.*

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*The writer believes that the only location in which one of these "pendulum ampere-meters" failed to work with reasonable accuracy was a case where it was installed on the switchboard of a yacht.

When the first model of this ammeter was submitted to Mr. Edison, he approved its construction and ordered six to be made at once for Cumberland station, requesting that he should be notified after they were finished and boxed, as he wished to see them when they were ready for shipment. This procedure appeared at the time to be a little mysterious, but was subsequently explained.

The six ammeters were accordingly built and carefully packed in separate boxes ready for shipment. Mr. Edison was then notified and he soon came around to look them over. Seeing the six boxes on the floor of the testing room, he ordered them to be placed on the center table, and then to our utter amazement, he told a laborer to mount the table and *kick the boxes off onto the floor*, "and give it to 'em good and hard."

Expostulation was vain, "If they won't stand being kicked off the table, they will never reach Cumberland in working condition," he said.

After this *test* the boxes were opened, and according to the writer's recollection, the "pendulum" ammeters were found to have passed the ordeal without material injury. Mr. Edison therefore permitted them to be repacked and shipped to Cumberland. The writer also went there and connected them in circuit, after which no further complaints were heard.

This was the first three-wire Edison station in which the dynamos were furnished with individual ammeters, the ready-made *hot-wire current-indicators* previously tried by the ingenious colored attendant having proved hardly accurate enough to prevent the excessive overloading and consequent destruction of the dynamo armatures.

Aluminum Solder

A solder has been invented whereby aluminum is easily soldered. It was discovered that by combining tin, zinc and aluminum with chloride of sodium in certain proportions a new composition is formed which has many valuable properties. In making the compound these elements are fused together in the proportion of twelve parts tin, two parts zinc, and one part aluminum. One per cent chloride sodium is added to this alloy. By varying these proportions somewhat the composition formed by them may be made harder or softer according to the various uses to which it is to be put. Sometimes a small amount of metallic antimony is added which increases its hardness without materially changing the nature of the composition.

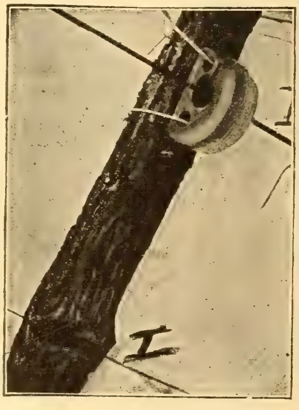
The alloy is pure white color, and is capable of receiving a high polish, which will not tarnish. It may be molded, welded, and worked in many ways. One of the valuable uses claimed for it is that it will adhere strongly to many metals, to glass, and to other substances without the use of flux and without any special preparation of the surfaces to which it is to be applied.

It may be applied by an ordinary soldering iron, but the use of copper for this purpose is not necessary.

This composition is particularly adapted to soldering aluminum, as it adheres to it strongly and is as readily applied to it as it is to other substances, such as copper and tin. Bars and wires of aluminum and other substances may be welded together by its use. Its high conductivity and the fact that it is not subject to electrolytic disturbances make it of value in soldering or welding electrical conductors of copper or aluminum or other suitable material.—*Mining and Scientific Press.*

It Helps the Trouble Man

The telephone trouble man finds plenty to do during wet, rainy weather if his lines run through wooded districts or along highways lined with shade trees. Here and there in the course of time wires will come in contact with tree branches and become grounded, or from the swaying of the limbs by the wind will wear into the bark and wood as shown at



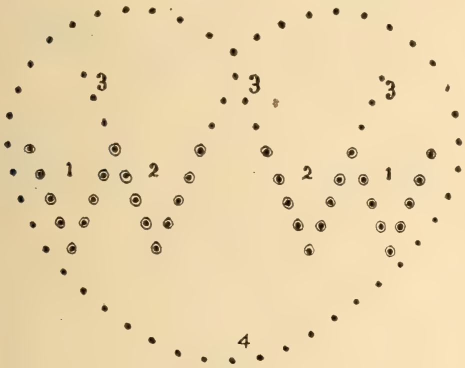
GLASS TREE INSULATOR

(I) in the illustration. The Scott glass tree-insulator shown in the upper portion of the illustration is designed to get rid of many tree-ground troubles and to reduce the cost of line maintenance, as it can be applied without cutting the wires, allows the limb to move without a strain on the wire and is inexpensive.

Impressive Electrical Wedding Decoration

In this particular case the initial letter of the family name of both bride and groom chanced to be "W." The letters, "WW" were formed of four candlepower, round bulb frosted lamps wired on a background of light wood-work carved to represent a heart, as shown in the cut.

Suspended above the altar rail the entire design was thickly filled with white chrysanthemums. These were not only in keeping with the occasion but also served to obstruct the view of the unlighted lamps. The four circuits, as shown, were operated by their respective switches. The church being otherwise brilliantly illuminated the design was not lighted until after the wedding party's arrival.



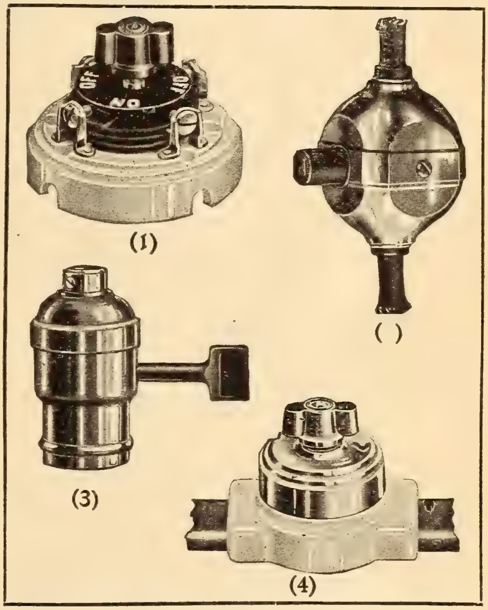
WIRING FOR WEDDING DECORATIONS

As soon as the wedding march announced the happy couple's approach up the aisle the lamps forming the heart were lighted, and immediately upon their arrival at the altar the two small "W's" were displayed. When the words were pronounced that made them man and wife, circuit No. 1 was opened and No. 3 closed, thus making one large "W" of the two smaller ones. Inasmuch as the congregation or spectators were not prepared for this, the effect was very impressive and altogether appropriate.

Practically the same results may be obtained with the use of any two letters, it being only necessary to simultaneously extinguish the smaller letters and light the larger one. The lamps in the larger and center letter can easily be arranged not to conflict with the others, and (depending upon the designer's ingenuity) some of the lamps of the letters can be made to do double duty.

Innovations in Wiring Devices

A 600-volt snap switch is shown in Cut 1. The cut is three-eighths full size. The trouble in making a snap switch for such a high voltage, heretofore has been to prevent destructive arcs when the contact is broken. Cut (2) is a switch to be placed on a drop cord above the lamp so that you need not reach under the lamp shade to turn off the light. Cut (3) is a socket which may be covered by a canopy through which the long key projects to turn the light on and off. Cut (4) is a switch with an insulating base for metal moulding.



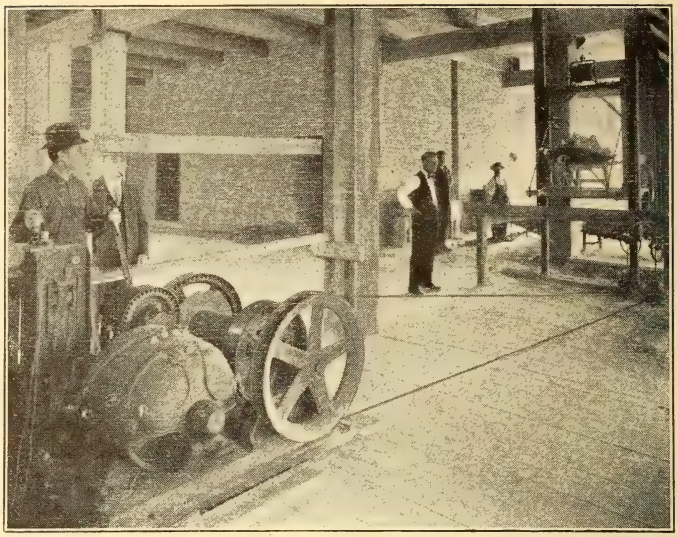
To Cut Glass

Pass a hempen cord soaked in turpentine over the place where it is desired to cut the glass, light it and sprinkle the glass with cold water, whereupon a slight pressure will suffice to break it sharply along the line followed by the cord.

Exit the Hod Carrier

In these days of competition and close bidding the building contractor utilizes every means of systematizing work and increasing the already rapid facilities by which a skyscraper can be hurried to completion.

The accompanying illustration shows how the human hod carrier is displaced by one of electric origin which almost shoots its wheelbarrows of brick and mortar to the upper floors of the structure in less time than it takes to wheel the brick from the entrance of the building to the lift. As one lift is going up the other one comes down. In a run of eight hours 125,000 bricks have been conveyed by this apparatus to the twelfth floor of a building in process of erection.

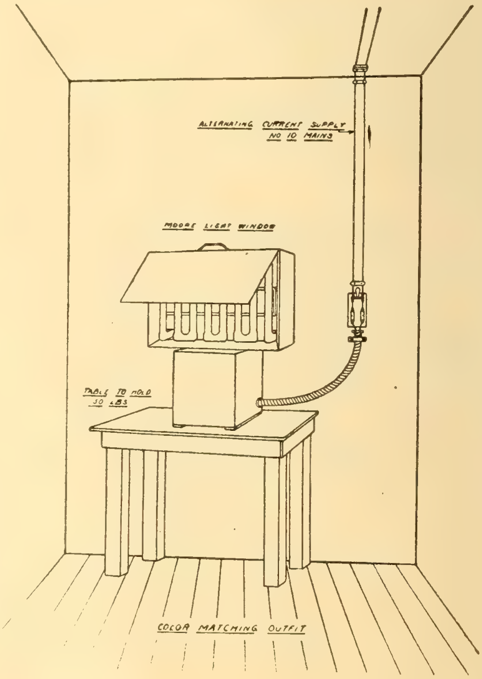


HOW ELECTRICITY DISPOSES OF THE HOD CARRIER

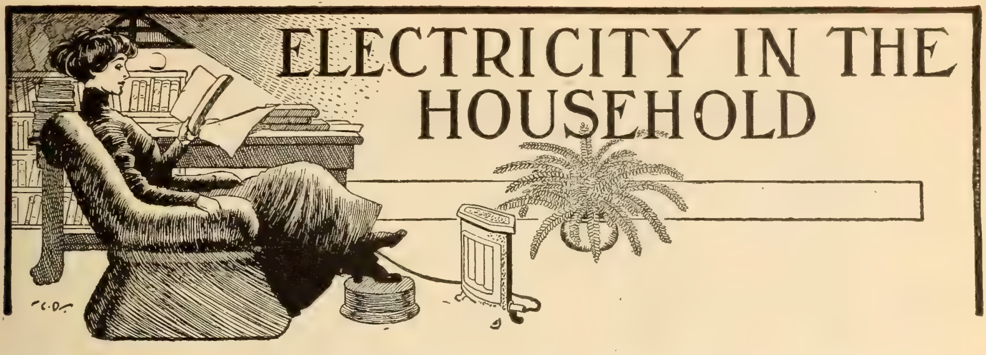
Moore Light for Matching Colors

The Moore system of vacuum tube lighting, as has previously been explained in Popular Electricity, embodies the principle of passing an alternating electric current through highly rarified carbon dioxide gas confined in a continuous clear glass tube. The light so produced is clear white; that is, it is similar to sunlight, and it is therefore particularly valuable where color values are of great importance, as, for instance, in matching colors in dye shops, lithographic establishments, textile mills, etc., where it can be used literally to turn night into day.

To adapt the system to work of this nature the apparatus is now put up in compact unit form as shown in the drawing. The upper portion of the apparatus, known as the "window" consists of a number of vertical "Moore tubes" in a sheet metal case about the size of a suit case. The side of this case opens out at an angle to form a reflector and shade. Below the case is a transformer to change the voltage of the ordinary alternating lighting current to a value adaptable for use in the tubes, with a leading-in cable from the service switch mounted on the wall and convenient to the hand of the operator. The transformer and tubes are mounted on a strong table located wherever convenient in the shop.



COLOR MATCHING OUTFIT

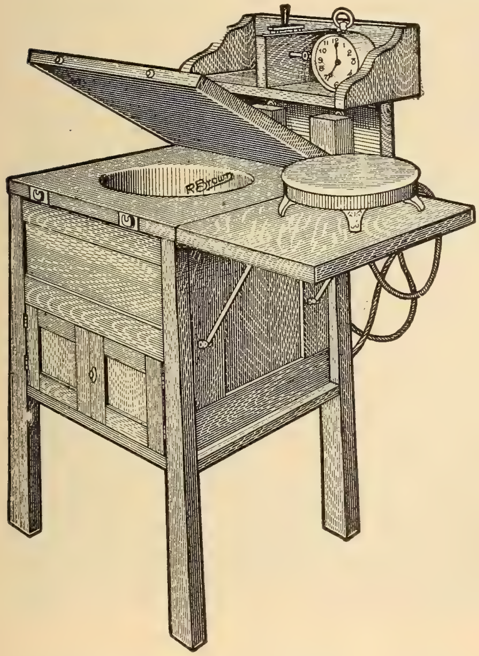


ELECTRICITY IN THE HOUSEHOLD

Electric and Fireless Cook Stove Combined

Those familiar with the economies of the fireless cooker will appreciate the combination of this device with the convenience and cleanliness of the electric stove.

The outside of the Hastings cabinet stove is made of finished hardwood. The containing compartment is lined with non-rustable metal between which and the woodwork is a fire-proof non-heat-conducting packing, through which wires pass to the electric stove located in the bottom of the receptacle. If the length of time required to bring a certain meat or vegetable to a boil is known, the dish containing it is placed in the receptacle, and the cover closed. Then the alarm of the clock is set to go off in 20 minutes, a half-hour, or in such time as the case may require. Closing the switch starts the cooking. When the time is up the clock sounds the alarm and at the same time opens the switch, and the cooking then continues as in a fireless cooker. This stove enables "the lady of the house" to start the evening meal, go shopping while it is cooking and return to find it ready to serve piping hot. A drop shelf is provided on the side, while a compartment beneath the cooker permits the storage of cooking utensils.

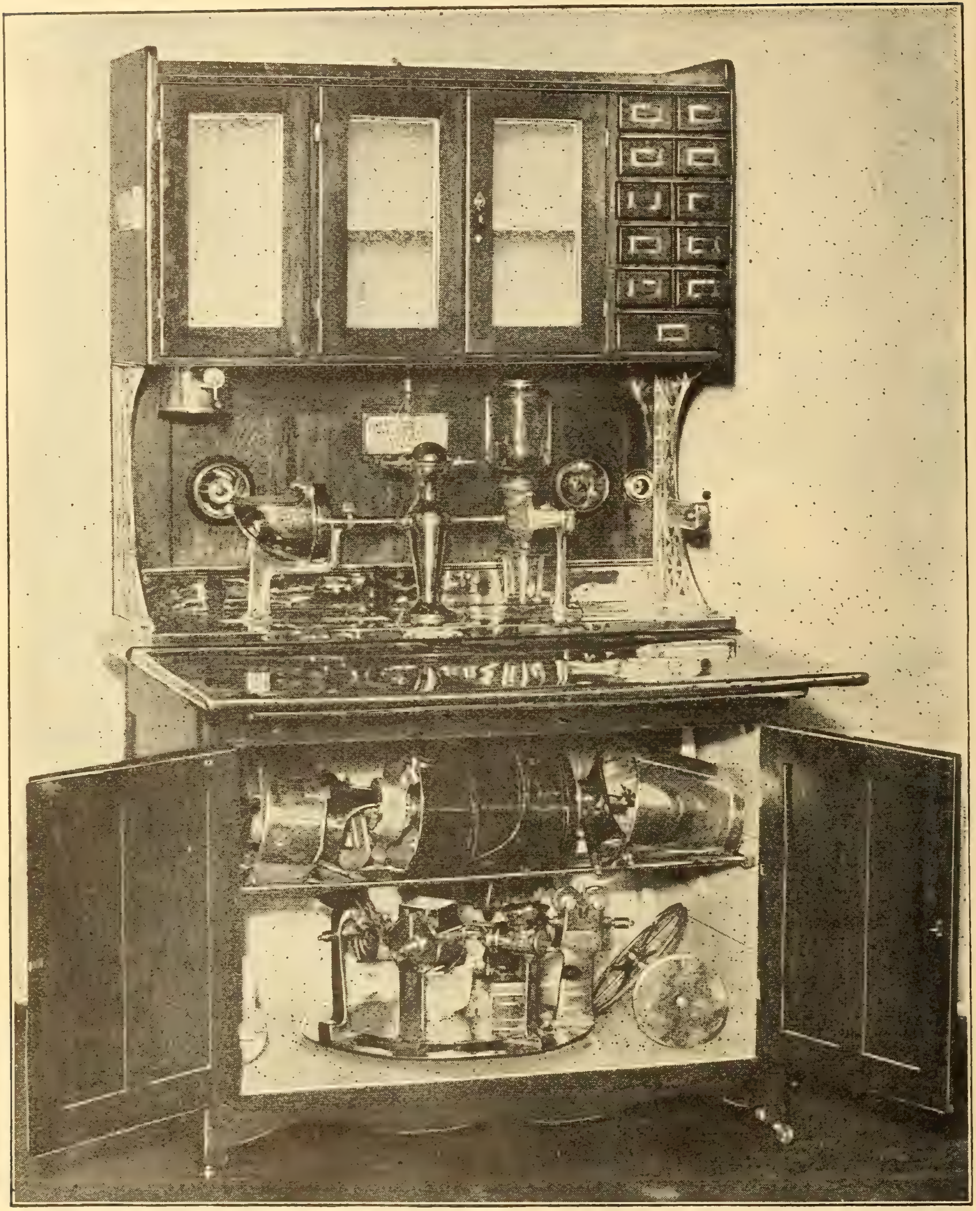


COMBINED FIRELESS COOKER AND STOVE

A Wonderful Kitchen Cabinet

The Federal electric kitchen cabinet is designed to fill a particular need. It resembles the ordinary kitchen cabinet somewhat, but is provided at the center near the back of the table with a shaft head from which project two arms to which various utensils may be attached by setting their bases into a groove, sliding them up against the shaft arm and clamping in place. A turn of a switch on the back of the cabinet starts a small motor, and electricity does the rest. It is not necessary to stop the motor to connect or remove any one of the several devices.

The various pieces, eleven in number, which make up the cabinet are kept on racks in the cupboard under the table. There is a bread mixer large enough to mix dough for four loaves, a cake mixer which, with proper ingredients at hand, begins the preparation of most delicious angel-food cake. Then there's an egg beater, a vegetable slicer that makes a slice as thin as paper or a quarter inch thick from a potato or beet; a coffee



KITCHEN CABINET WITH ELECTRIC CONVENIENCES

grinder, a meat cutter, a potato and lemon grater, a cherry pitter, a knife sharpener, a knife polisher, and last but not least a two-quart ice cream freezer.

The cabinet is built of oak. The top of the table is of heavily nickel-plated sheet metal which is easy to clean.

By means of an extension shaft a sewing machine, dishwasher or washing machine may be operated. A flour bin and cupboard above the table add to the usefulness of this piece of electric furniture which will make the kitchen the playroom rather than the workroom of the home.

Where Art and Science Meet

By T. VERNETTE MORSE

Every housewife knows that a dainty breakfast cheerily served is a bright happy introduction to the day's work, yet there is something quite depressing in the fact that the first start towards breakfast is usually made in a kitchen where the thermometer has gone to sleep, and the cold, blustering, winter winds howl cheerlessly about the door. The woman who is able to overcome these *trifles*, and serenely prepare and serve breakfast in the sunny dining rooms, resolutely determines that her family shall begin the day aright, even at the sacrifice of personal comfort.

BREAKFAST DOES NOT MEAN QUANTITY, BUT QUALITY AND DAINTINESS

Breakfast does not mean quantity, but it does mean quality, and daintiness. The up-to-date woman knowing this, has not been slow to abandon the cheerless morning kitchen for the new and popular electrical dining room devices which admit of preparing the breakfast at the table.

While "John" is reading the morning paper she has gently turned a switch and the breakfast is quietly preparing itself. No smoke, no oil, no gas, just the savory odor of the percolating coffee, the neatly browning toast, the perfectly cooked eggs, the steaming hot cereal and the dainty cakes.

It is such fun to prepare these charming breakfasts that the children are anxious to assist and even "John" oftentimes finds it more interesting than the latest Washington news or stock reports. He becomes so absorbed in watching the process that he actually forgets how "Mother used to cook." Everyone feels a personal interest in preparation of a meal when electricity is used, for it so quietly and quickly does its work.

To trace the evolution and application of fuels from the original open fire place with its sturdy pots and kettles to the dainty appliances and utensils of the present is an interesting thesis in itself, but we have no time for stories, with electricity making such rapid strides and marching so jauntily right into the home.

The management of the Artcraft Institute, of which mention was made in the first chapter of this series, invited a party of club women to assist in conducting a series of "Electrical Picnics" at the recent Electrical Show in Chicago, using as a basis for these experiments the household equipment on exhibition.

A large dining table was supplied with coffee percolators, toasters, chafing dishes, water heaters, heating disks, and other necessary appliances.

The object of these experiments was to demonstrate to these women the fact of the actual arrival of electricity, as a household necessity, and to show them that such things, for instance, as the preparation of a dainty breakfast on the dining-room table, as I have outlined above, are practical possibilities and not merely the dreams of some silver-tongued salesman of electrical apparatus.

Each day during the exhibition different groups of club women prepared and served a breakfast, luncheon or dinner, on the table. using only the electrical devices named. One of the special features was a seven-course dinner. The day Mrs. Minnie Starr Granger, president of the Federation of Illinois Women's Clubs, was guest of honor, a "Picnic Luncheon" was attractively served by the vice-presidents of the Chicago districts.

As different women were in charge of the table and menus each day, a great variety of experiments was attempted and the cooking contests grew in interest until everyone was anxious to try something new.

Washing dishes when the water is heated in a sparkling glass globe at the table becomes a pretty accomplishment, requiring as graceful handling as the serving of a cup of tea.

The writer in arranging the series of afternoon entertainments at the Electrical Show was ably assisted by the following well known women: Mrs. David W. Beggs, Mrs. Frank L. Bellows, Mrs. Freeman E. Brown, Mrs. A. P. Coon, Mrs. George E. Colby, Mrs. Frederick A. Dow, Mrs. Edward E. Ellicott, Mrs. Laura E. R. Fischer, Mrs. Frank M. Gage, Mrs. F. Albert Jones, Mrs. John F. Thompson, Mrs. Glenn Steere, Mrs. George P. Vosbrink, Miss Olive Russell Chapin, Miss Glenna Lynch, Miss Martha Matthews, and Miss Frances Thompson.

If any of this competent group of women doubted the practicability of cooking by electricity, the doubts were most satisfactorily dispelled by the success of the practical experiments, which are now being put into actual practice at the Artcraft Institute.

We are also planning tables and cabinets especially adapted to the use of electrical appliances, for electricity demands a style of its own in table furnishings, a style especially suited to the new epoch which is gradually opening the doorway of ideal housekeeping.

Electricity has come to stay. If it is sanely installed in the homes, without bringing with it the useless frills and furbelows, that seem destined to accompany every progressive movement, it will solve many of the problems which have hitherto confronted the housewife. It is safe, clean, and when properly used is economical. Most of the utensils are good in form, simple in construction, having no complex scheme of decoration. Consequently, they will not, in a few years, become extravagant examples of inartistic excitement and misapplied design.

Below I give a few of the breakfast menus, which can be prepared and served on the table.

BREAKFAST NO. 1.

Oranges Puffed rice and cream.
Scrambled eggs on toast.
Ladyfingers
Coffee Tea.

BREAKFAST NO. 2.

Grapefruit
Oatmeal with cream and sugar.
Minced ham and eggs.
Buttered toast.
Cookies Coffee.

BREAKFAST NO. 3.

Grapes.
Wheatena with cream and sugar.
Buckwheat cakes, syrup.
Coffee cake. Coffee.

BREAKFAST NO. 4.

Apples.
Puffed wheat with cream and sugar.
Creamed potatoes Sausage.
Buttered toast
Oatmeal cakes Coffee.

BREAKFAST NO. 5.

Oranges.
Oatmeal with cream and sugar.
Boiled eggs. Buttered toast.
Cup cakes. Coffee and chocolate.

BREAKFAST NO. 6.

Grapefruit
Breakfast food with cream.
Creamed codfish with poached eggs, on buttered toast
Rolls.
Ginger drops Coffee and chocolate.

These simple breakfasts daintily prepared on the dining-room table are most attractive and save the housewife and mother many of the unnecessary steps.

JUNIOR SECTION

Construction of Small Motors and Dynamos

By **CHAS. F. FRAASA**

CHAPTER III.—ARMATURE CORES

Fig. 10 shows one of the armature disks. These disks are made of sheet iron, and should be turned very smooth and round. Around the periphery are a number of slots in which the armature winding is placed. The portion of iron between the slots is known as the armature tooth. In the center of the disk is a hole for a shaft.

The ratio of the diameter to the length of the armature is the same as that of the field bore, after allowing for the air gap. This ratio was given in Chapter II.

In all of these small models, the armature is of the laminated type of construction, that is, composed of a great many sheets, all assembled side by side on the shaft. The simplest way to make the armature is to bolt all of the plain disks together on the shaft; but to get best results the sheets should be shellaced or enameled on one side, or better still, be separated from one another by thin sheets of paraffined tissue or other paper.

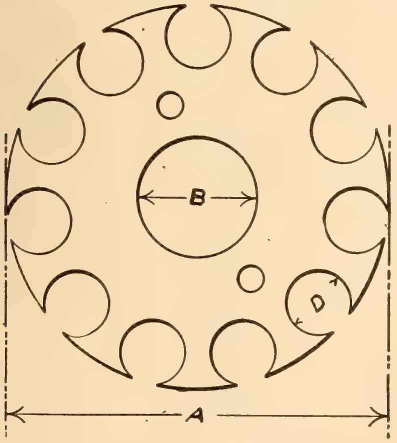


FIG. 10. ARMATURE DISK

The dimensions of the armatures for these models should be as specified in Table II. referring to Fig. 10.

TABLE II

DATA FOR ARMATURES, REFERRING TO FIG. 10

TYPE	A	B	D	LENGTH OF CORE	NO. OF SLOTS
A	$3\frac{1}{4}$″	1″	$\frac{1}{2}$″	$3\frac{1}{4}$″	11
B	$3\frac{1}{2}$″	1″	$\frac{5}{8}$″	$3\frac{1}{2}$″	11
C	$4\frac{1}{4}$″	1″	$\frac{1}{2}$″	$4\frac{1}{4}$″	13
D	5″	1″	$\frac{1}{2}$″	5″	15

In constructing the armature, cut the two end plates, one for either end, and the sheet iron into rectangular shape, 4 by 6 inches. The stack should be $3\frac{1}{4}$ inches thick when tightly clamped together, by means of bolts passed through notches in the sheets, and holes in the end-plates.

Describe a $2\frac{3}{4}$-inch circle on the end plate and drill a one-inch hole for the shaft at its center. This may seem to be a large shaft for this size motor or dynamo, but, since it is to be built on the machine, it must be of this size. Around the circumference of the $2\frac{3}{4}$-inch circle, using points on it as a center, drill eleven equally spaced ($\frac{1}{2}$-inch diameter) holes. The armature is now ready for turning, but the turning may be more rapidly and accurately done if the end plates and the sheets are first cut down almost to size, say $3\frac{3}{8}$ inches in diameter, using the machine to true them up, and opening the $\frac{1}{2}$-inch holes to form slots. At a radius of $\frac{7}{8}$ inch from the center, drill two $\frac{1}{4}$-inch holes on opposite sides of the shaft through the armature. Put two $\frac{1}{4}$-inch bolts through these holes and tighten the nuts.

The next step is to prepare the boring machine for turning (Fig. 11). Make a tool-holder as before, with a piece of pipe of the same diameter as the other tool-holder, and use four lock nuts. Drill a hole through the timber of the machine bed, and through this hole put the tool-holder after having threaded it from end to end, and fasten it there by tightening the lock nuts on either side of the wood, as shown in Fig. 12. The pipe should be long enough to extend about two inches above the center of the shaft of the machine. Near the top, cut a slot wide enough for the tool, and putting the tool in place, clamp it between the two nuts. Now put the armature on the shaft of the machine, and fasten it to the original tool holder by means of a bolt passed through one of the armature slot holes and through the slot in the tool holder. It would be better if two slots, opposite, were connected to the tool holder in this way.

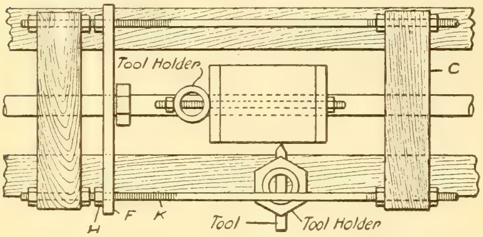


FIG. 11. BORING MACHINE ARRANGED FOR TURNING

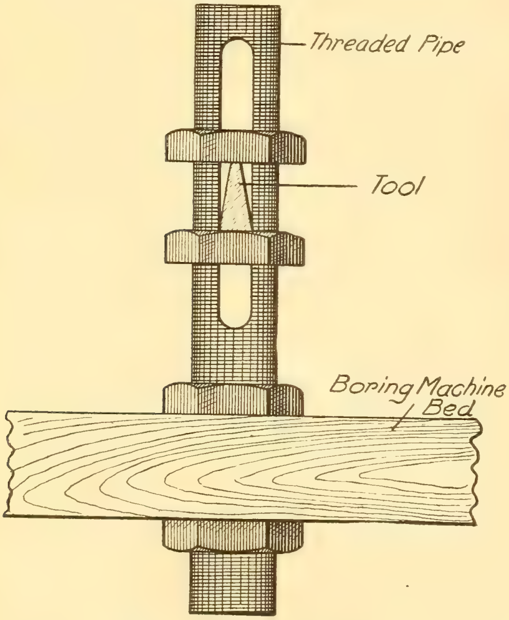


FIG. 12. TOOL HOLDER

Set the tool to cut to the proper diameter if using a side tool, but if using a tool like the one shown in Fig. 11, set it to take a very light cut, drive the foot-power and feed up the work by means of the feed device. The armature will then rotate and move before the tool, and will be turned perfectly round on the shaft with its center and the center of the shaft coinciding.

After the armature is machined, it should be removed from the shaft, and the disks insulated from one another by either a coat of shellac, or enamel, on one side of each disk. The disks should then be carefully assembled on the shaft while the separating insulator is still soft, and tightly clamped together again.

(To be continued.)

Simple Galvanometer

A simple galvanometer for approximately determining the strength of electric currents may be made up as follows:

First procure a small compass mounted in a containing case about 1¼ to 1½ inches in diameter. Now bore a hole in the center of one side of a wooden block about 2½ inches square, of such a diameter that the compass case will fit snugly into it. This hole should be bored to such a depth that the center of the compass needle will be in the exact center of the wooden block when the needle is in place. Cut two grooves all the way round the block as shown in Fig. 1, the grooves being ½ inch wide and ½ inch deep. Wind in each of these slots twelve layers of No. 24 B. & S. double cotton-covered copper wire. These coils should both be wound in the same direction and the inside end of one connected to the outside end of the other which results in the current flowing around the two coils in the same direction when the remaining two terminals are connected in a circuit. The compass should, of course, be placed in a the wooden block before the wire is wound on, and it can be held in place by means of some shellac put in the bottom of the hole.

Mount the compass case in such a position with respect to the block that the needle will be at zero when it is parallel to the planes of the two coils as shown in Fig. 2.

This part of the galvanometer should now be mounted on a wooden base whose dimensions correspond approximately to those given in Fig. 2. Two back-connected binding-posts may be mounted on the base that will serve as terminals for the instrument and the free ends of the coils should be connected to them on the under side, the wires being placed in grooves cut in the base. The completed instrument should be given two coats of shellac and you are ready to calibrate it, which can be done by connecting it in series with an instrument whose indications are known.

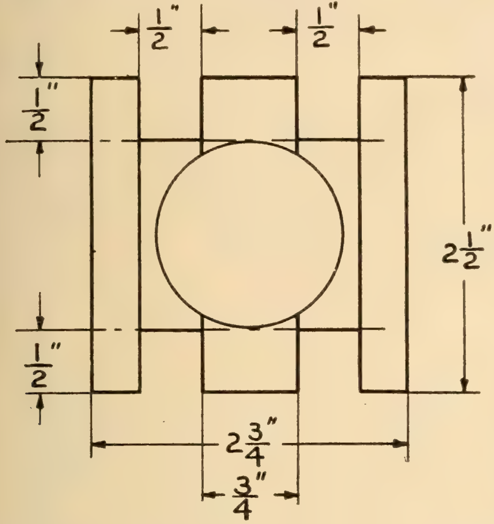


FIG. I. MOUNTING BLOCK OF GALVANOMETER

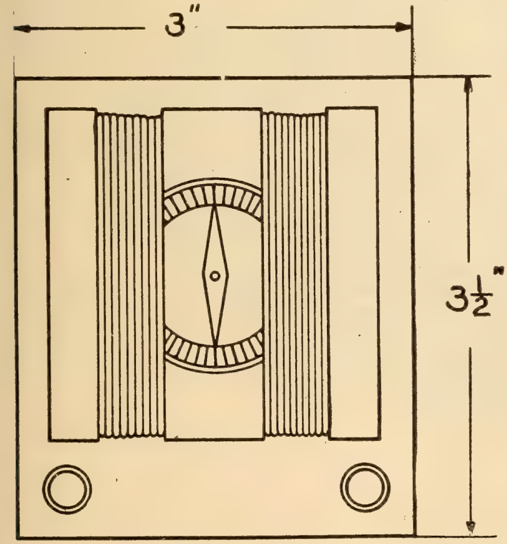


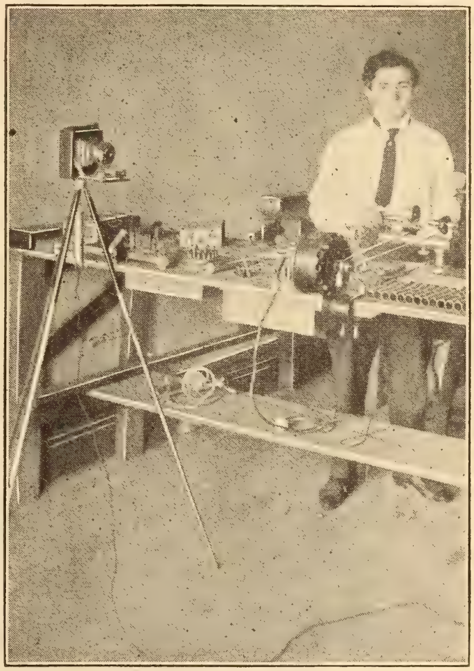
FIG. 2. ARRANGEMENT OF GALVANOMETER COILS

This instrument can be made to indicate the value of larger currents by winding it with larger wire and using a smaller number of turns. It can also be made to indicate small currents by decreasing the size of wire and increasing the number of turns.

Self Photography by Electricity

A device which enables a person to take his own photograph by means of electricity and compressed air has recently been perfected by Karl Thalhammer, a young Austrian inventor living in Los Angeles.

It consists of a metal cylinder about six inches long, which contains an air compressor and an electrical mechanism for releasing the air pressure, and a small dry cell. This cylinder hangs from the tripod and is connected with the rubber air-tube that opens and closes the camera shutter. A double length of fine, insulated wire is attached to this cylinder and connects with a smaller cylinder held in the operator's hand, this cylinder containing another tiny dry cell. A slight pressure of the thumb is all that is required to electrically release the compressed air for a snap shot, or, if a time



ELECTRICALLY OPERATED CAMERA

UNUSUAL PICTURE TAKEN WITH ELECTRICALLY OPERATED CAMERA

exposure is needed, a second pressure will close the shutter.

The cylinder is so small that it will not show in the hand, and the wire can be adjusted so that it will be inconspicuous.

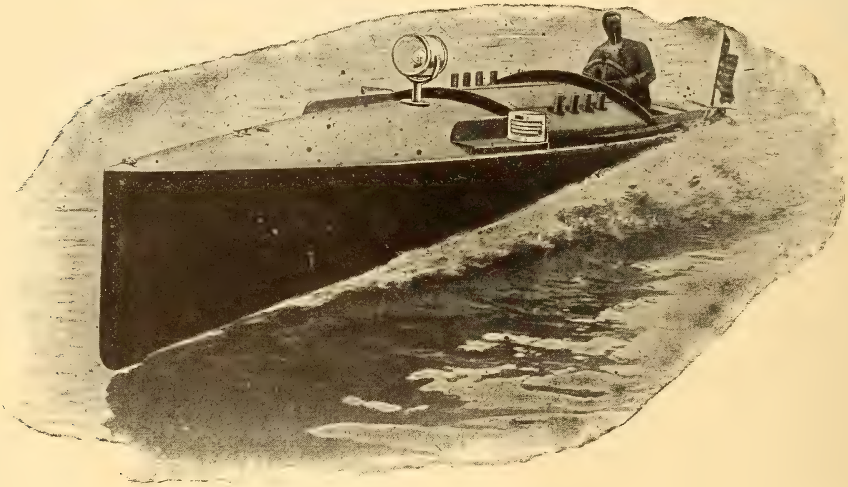
The operator desiring to take his own picture should first carefully adjust the camera to include the place in which he expects to pose, getting the focus upon some object on that spot, like a twig or a stone.

Its greatest value is to the solitary traveler or explorer who can bring back photographic proofs that he has visited some particular place. That phase of its use is shown in the photograph herewith of Paul Reinwald, the famous mountain climber, who took this picture of himself in peculiar pose on Mount Baldy in Southern California, Christmas day, 1909.

The value of this device to the amateur photographer lies in the fact that he can include himself in a group of friends when there is no friendly stranger to "press the button."

Motor Boat Searchlight

Nosing about after dark among other craft with an expensive motor boat requires that some precaution be taken to prevent a costly accident. Compared with slow going craft the motor boat is the automobile of the water and should therefore be equipped with just as good a head light as the wheeled vehicle. The accompanying picture shows such a boat equipped with an electric searchlight. Inside the swinging reflector is a low-voltage, heavy filament tungsten lamp of from 10 to 25 candlepower. This is operated from a storage battery and sends out a surprisingly powerful beam of light.



MOTOR BOAT SEARCHLIGHT

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine will be devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART XI—DETECTORS (CONTINUED).

The moving parts of the detector are assembled as in Fig. 123. A small spiral spring is formed by wrapping some fine piano wire around a small brass rod, and placed on the shaft between the wire ring and a small brass washer ⅜ inch in diameter and 3-16 inch thick. The shaft passes through a hole in the centre 13-64 inch in diameter. The washer as well as the "barrel" are soldered to the arm.

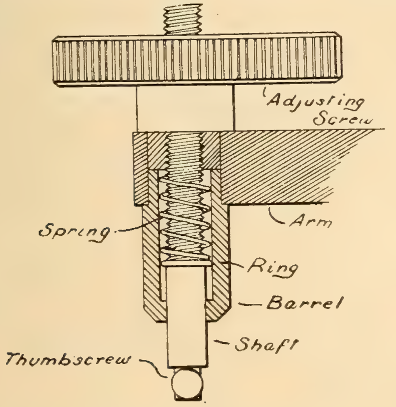


FIG. 123. MOVING PARTS OF A DETECTOR

When the hard rubber adjusting head is turned in one direction it will raise the shaft, but when turned in the opposite direction the spring forces it down.

The brass arm is secured firmly to the hard rubber standard Fig. 124, by a brass rod which passes through the longitudinal axis of the latter. The rod is 2¾ inches long. The ends are threaded with an 8-32 die. A hexagonal nut having a similar thread is placed on the lower end. A composition knob similar to that used on the adjusting rods of the oscillation condenser is screwed on the top. The arm is kept from moving sideways by two small brass pins which pass, one from the arm into the standard and the other from the base into the standard.

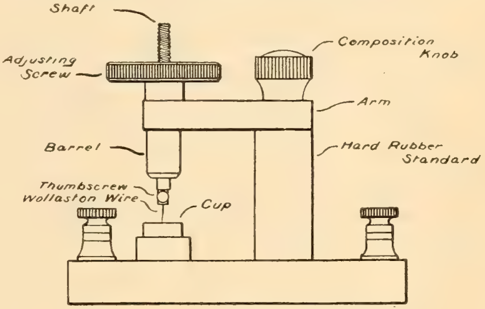


FIG. 124. COMPLETE DETECTOR

The cup to contain the electrolyte, Fig. 125, is a piece of hard, close-grained graphite rod. The variety used for making brushes for dynamos and motors is preferable since

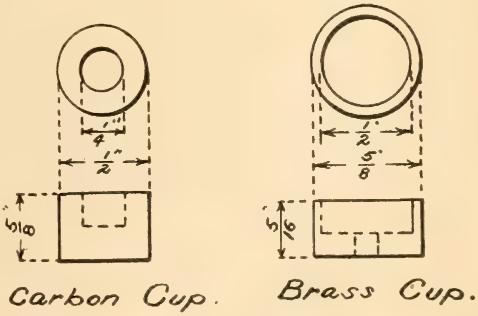


FIG. 125. THE CUP

it is non-porous. The cup is ½ inch in diameter and ⅝ inch deep. A small recess, ¼ inch in diameter and 3-16 inch deep is bored in the top to contain the acid. This may seem to some to be an unusually small amount of electrolyte. But a few drops of acid are preferable to a large quantity. The acid does not then move very easily and the detector is not so liable to be thrown out of adjustment by jolts or jars.

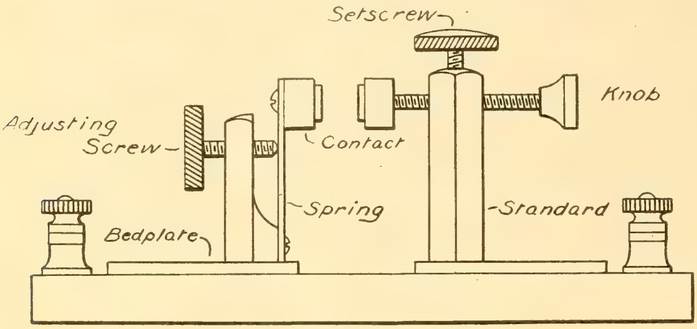


FIG. 126. MINERAL DETECTOR

The carbon should fit snugly into a brass cup ⅝ inch in diameter and 5-16 inch deep. The recess in the top of the brass cup should be made ½ inch in diameter and 3-16 inch deep. The cup is fastened directly under the lower end of the shaft. A small brass screw passes through the base into a threaded hole in the bottom of the centre of the cup.

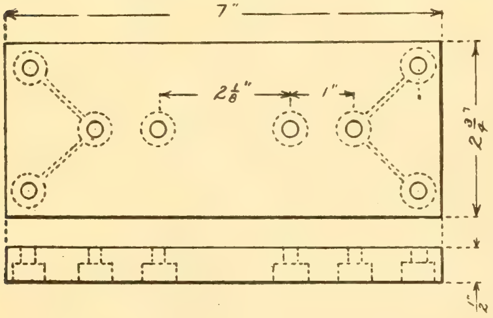


FIG 127. BASE OF MINERAL DETECTOR

Connections are established by copper wires inlaid in grooves in the under side of the base. Two of the binding posts are connected to the cup and the other two to the lower end of the rod which passes through the arm and standard.

The detector shown in Fig. 126 is illustrated for the benefit of those experimenters who for some reason or other prefer to use minerals.

This detector is especially suitable for use with carborundum crystals, it being employed for that purpose by the United Wireless Telegraph Company.

The base, Fig. 127, is a piece of polished hard rubber 2¾ by 7 by ½ inches. The standards are made of hexagonal brass rods ⅝ inch in diameter. The tallest standard is two inches high. The top is turned slightly convex to present a good appearance. It is bored and tapped to receive an 8-32 knurled thumbscrew having a head ⅞ inch in diameter. The lower end is bored and tapped to receive an 8-32 machine screw which holds it to the base. A 5-32 inch hole is bored at right angles to the axis of the standard 1 1-16 inches from the lower end.

The smaller standard is 1½ inches high. One face is ground away as shown by the detailed drawing in Fig. 128. A knurled brass thumbscrew, Fig. 129, ⅞ inch in diameter and one inch long over all passes through the standard 1 3-16 inches above the lower end. The end of the thumbscrew bears against a brass spring ⅜ inch wide and 1 15-16 inches long. The spring is fastened to the standard by means of two small round headed brass screws. The lower end of the standard is bored to receive an 8-32 machine screw which holds it to the base.

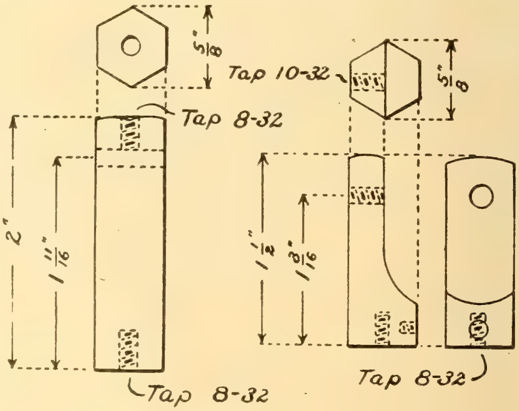


FIG. 128. DETAILS OF STANDARDS

The standards are mounted on a brass bed-plate which serves to make them firm and also to give the detector a more finished appearance. The bed plates are two inches long, $\frac{7}{8}$ inch wide and $\frac{1}{8}$ inch thick.

The electrodes are two circular pieces of brass, Fig. 130, $\frac{1}{2}$ inch in diameter and $\frac{3}{8}$ inch thick. They are bored and tapped to fit an 8-32 thread. One is fastened to the spring by means of a small machine screw. The other is fitted on one end of a 5-32 inch brass rod two inches long. The other end of the rod is fitted with a small composition knob. The rod passes through the hole in the largest standard.

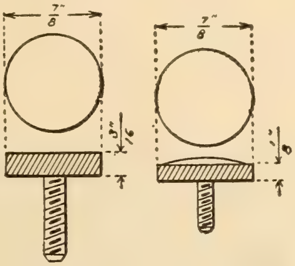


FIG. 129. THUMB SCREWS

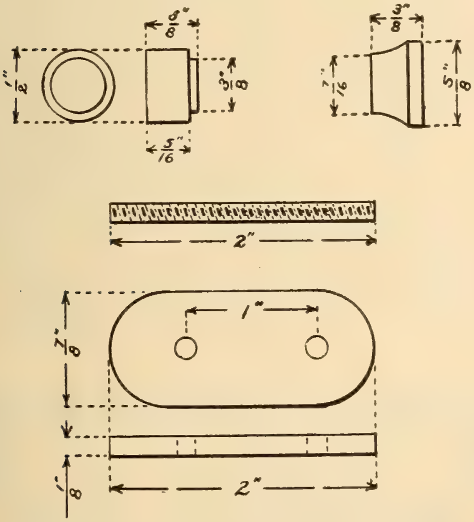


FIG. 130. BED PLATE ELECTRODE AND HANDLE

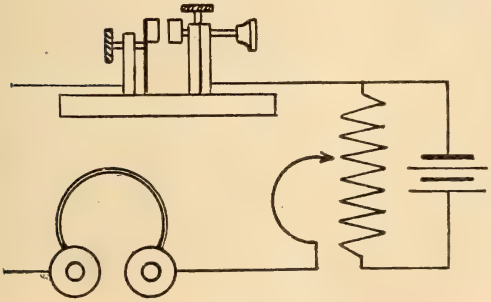


FIG. 131. DETECTOR CIRCUIT

The base is fitted with four binding posts, one near each corner, two connected to each standard. The connecting wires are inlaid in grooves in the bottom of the base. The circuit is shown in Fig. 131.

The following is a partial list of the minerals and crystals useful as wave detectors for wireless telegraphy.

Carborundum crystals are the only ones requiring a battery

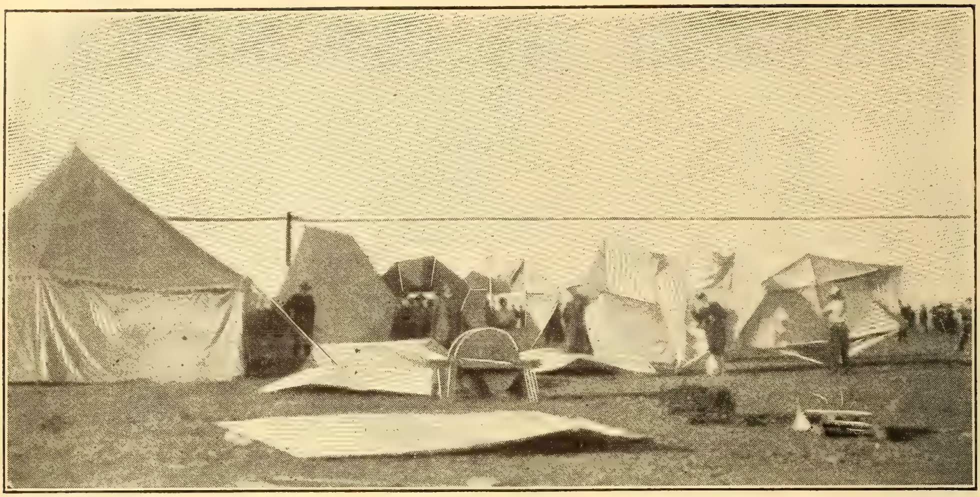
Mineral Name	Chemical Name
Carborundum	Silicon Carbide
Fused Silicon	Silicon
Iron Pyrites	Iron Sulphides
Copper Pyrites	Copper Sulphide
Chalcopyrites	Copper Iron Sulphide
Hessite	Telluride of Silver and Gold
Zincite	Zinc Oxide
Octahedrite	Oxide of Titanum
Stibuite	Antimony Sulphide
Galena	Lead Sulphide
Molybdenite	Molybdenum Sulphide
Zirconium	Zirconium
Niccolite	Nickel Arsenide
Domeykite	Copper Arsenide
Sphalerite	Sulphide of Zinc
Pyrrholite	Iron Sulphide
Corundum	Oxide of Aluminum and Iron.
Hematite	Iron Oxide
Cassiterite	Oxide of Tin
Siderite	Iron Carbonate
Malachite	Copper Carbonate.

(To be continued.)

Wireless at the Los Angeles Aviation Meet

At the recent aviation meet held at Los Angeles, California, the United Wireless Company installed a two K.W. station on the aviation field in order to send the daily flying news to a big Los Angeles newspaper. The installation was novel in many ways, the aerial being attached to one of the ten-foot man-carrying kites which was on exhibition at the meet. The aerial was a single No. 12 aluminum wire 300 feet long. The kite was raised 500 feet in the air and the aerial wire ran from the kite string to a tent on the field. The instruments used were of the DeForest type consisting of a loose coupler, silicon detector, 2,000-ohm phones and receiving condenser.

For sending there were used a two K.W. transformer, a condenser of the Leyden jar type consisting of 12½ gallon jars, helix, anchor gap and key. The transformer was operated on a 110 volt alternating current light circuit. With this set the operator, a



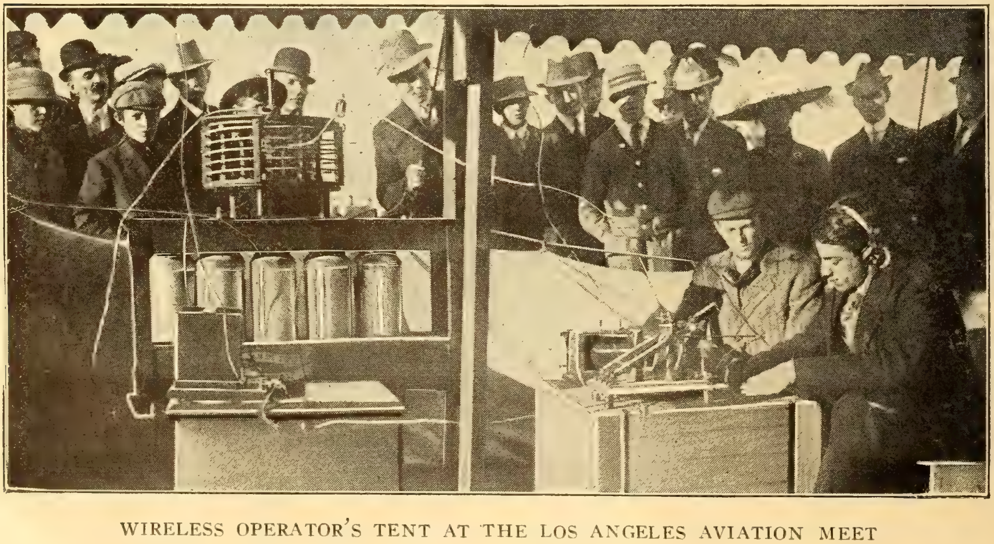
GETTING THE MAN-LIFTING KITE READY TO CARRY UP THE WIRELESS ANTENNA

Los Angeles amateur, was able to communicate with Los Angeles (P. J.), Catalina Island (P. I.), Point Loma (T. M.) the large coast steamer Yale and other ships at sea. The station which was open to the public was visited by several thousand people a day.

The United Wireless Company was to install a wireless set on one of the Wright biplanes but after the accident in which one of the Wright flyers, Arch Hoxsey was killed, the Wright manager refused to allow the instrument to be put up for fear of another accident.

Toward the last of the meet one of the Curtiss flyers, C. F. Willard, while circling the course in his machine at a 200 foot level ran into the aerial wire, bringing the kite to earth and smashing it badly. The aerial wire got tangled in his machine forcing him to descend. In landing he smashed the running gear and wing of his machine. Another kite was raised and the station resumed operation within fifteen minutes after the accident. The station was kept in operation all through the meet and transmitted and received from ten to 180 miles.

R. B. YALE.



WIRELESS OPERATOR'S TENT AT THE LOS ANGELES AVIATION MEET

Amateur Wireless at the Electrical Show

The story of the attention young men of the country are giving wireless was told at the exhibit of the Chicago Wireless Association at the Electrical Show where future Jack Binnses explained to an always interested crowd the mysteries of Hertzian waves.

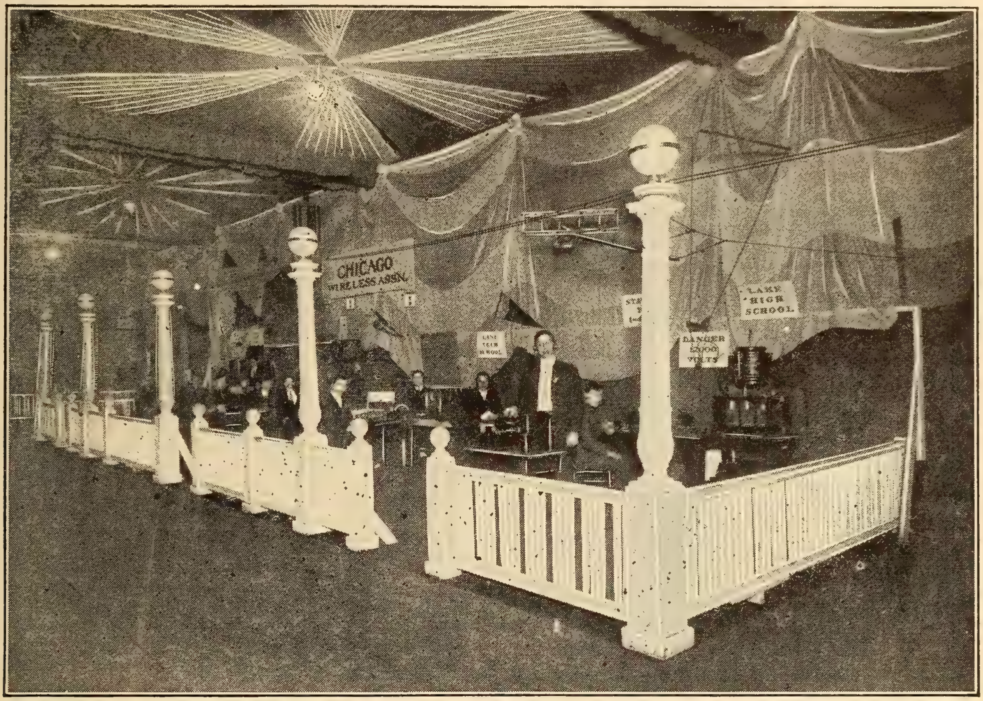


EXHIBIT OF THE CHICAGO WIRELESS ASSOCIATION AT THE ELECTRICAL SHOW

Several wireless equipments each in charge of operators demonstrated the manner of sending and receiving messages. An equipment, installed in the north balcony, as far away as the Coliseum would allow, served as a station with which the operators talked at different times. Much of the apparatus was home made, some of the devices having been built in the laboratories or shops of the school the students attend. Besides the Association apparatus the following Chicago schools were represented: Lake High, Lane Technical, Englewood and Crane Technical. Apparatus exhibited varied in capacity from ¼ K.W. to five K.W.

The Association which began as a club in 1907, has for its object the banding together of all amateurs in Chicago and within a radius of 200 miles. With an active membership around 200, meetings are held twice a month at the Atheneum Building, 18-26 Van Buren Street, at which members discuss various phases of wireless and listen to lectures by experienced men in the field. Among the topics recently discussed were: "Wireless and Life in the United States Navy" by W. W. Holzbaur, operator in the Navy, and "The Rotary Spark Gap." The officers of the Association are: E. Meullner, president; J. Hair, vice-president; J. Walters, Jr., secretary; C. Stone, treasurer. Applications for membership may be addressed to the Secretary, 6555 Langley Ave., Chicago.

Department Store to Install Wireless

Plans have been completed for the erection of two steel and wooden towers 125 feet high on the roof of the Wanamaker store at Broadway and Ninth Street, New York. The towers are to be used for a wireless telegraph station, which will communicate with a similar station connected with the Wanamaker store in Philadelphia.

Wireless Club Contest

The new P. E. W. C. membership list was sent out to all members on January 16th. It contains over 950 names and since January 1st, when the list was sent to the printer, a large number of new members have been added. As stated in the booklet, we believe the Club was never in a more prosperous condition. The members whose names are found in both this list and the old one have been with us since the beginning and their perseverance shows that they went into the wireless experimental work as something more than a passing fancy.

As the P. E. W. C. members have always been among the most loyal readers of the magazine we decided to make them an exceptionally good offer in the form of a subscription-getting contest, full particulars of which have been sent to each member. We have arranged this contest so that all can make their running expenses as they go along. We have also arranged so that every one who does good work can secure one of the special prizes—something that he needs every day in his experimental work. There isn't a member that cannot go out and get at least ten subscriptions before May 1st, entitling him to one of these special prizes. Probably most of you can go out and get several times ten thereby obtaining several of the "specials" and putting you well in the running for one of the grand prizes, which last are all of them worth a lot of effort.

As the contest ends April 30th, announcement of the names of the winners cannot be made in the May issue, but the announcement will be made in the June issue, although, of course, the prizes will be distributed long before that date.

And now a word in regard to your working methods: Remember, first, that those interested in wireless are not your only "prospects." Everyone is a prospective subscriber to Popular Electricity, because there is something in every issue to interest young and old, men and women alike. Don't forget that point; your grocer, your doctor, your dentist, your machinist friends, your favorite engineers in the power plants and pumping stations where you go to watch the machines, the blacksmith around the corner, the principal and teachers in your school, the firemen, the butcher, the storekeeper—all are interested in electricity, they will all be glad to listen to your arguments and to take out their subscription through you.

Sample copies are valuable to you in the work and we will be glad to send them to you as often as you ask for them. Also remember that each subscription you take must be sent in on one of the blanks given you, for these blanks constitute our record on which we are to finally compute the results of each one's efforts. When you run out of blanks send for more.

A Wireless Signal Intensifier

The following description of a device for rendering more distinct wireless signals, especially faint signals, is contributed by William Greotzinger: All that is needed is preferably a wireless receiving set using an electrolytic detector. Although any detector can be used, the electrolytic seems to give the best results. The intensifier or relay is shown in Fig. 1. (B) is the base and (WW′) are two wooden uprights. (CC′) are two carbons and are fastened to (WW′) by two binding posts (PP′). The carbons must have a sharp edge on the top. (M) is an electromagnet out of an old 75-ohm single-pole telephone receiver and is fastened to the base between the two carbons, the free ends going to the binding posts (HH′). Be sure to have the carbons a very little higher than the top of the magnet core so that when the needle (N) is laid across them it almost touches the core. When a message is coming in the detector makes the magnet a little stronger, which pulls on the needle and lets more current through the contact between the carbons and the needle, thereby operating a receiver or relay.

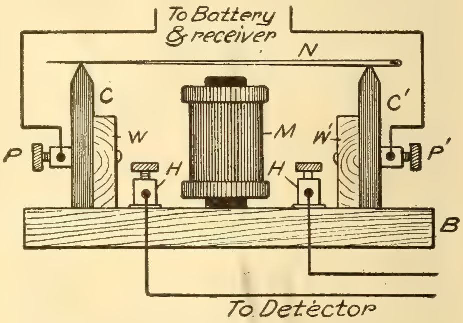


FIG. 1. SIGNAL INTENSIFIER

The connections are shown in Fig. 2. The intensifier merely takes the place of the wireless telephone receiver, and relays a strong current on to another receiver or sensitive relay. The instruments are adjusted as usual. Mr. Greotzinger states that he has had fine results with this instrument and weak signals have been increased to fully three times as loud.

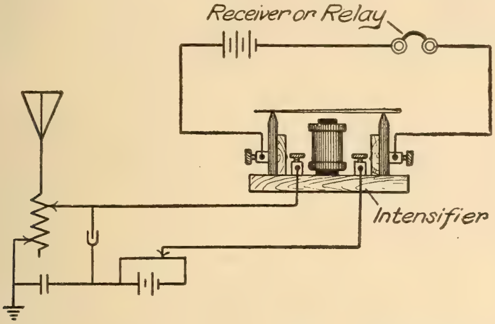


FIG. 2. CONNECTIONS OF SIGNAL INTENSIFIER

WIRELESS QUERIES

Answered A. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

Measuring Sending Current

Question.—Could you tell correctly when you were sending out the most amperage from an aerial by connecting an incandescent lamp in the aerial circuit?—T. R. D., Van Wert, Ohio.

Answer.—This method is fairly satisfactory, but since slight changes in the current passing through the lamp do not cause large changes in its brilliancy, and since the eye of the operator will not readily note small changes in its brilliancy because there is no standard to judge by, this method will not give as exact results as a hot wire ammeter.

Carborundum for Detector

Question.—Is the carborundum in the oil stones suitable for a detector if it is broken into small pieces?—A. A. MacC., Syracuse, N. Y.

Answer.—No, because the carborundum used in making these stones is in a powdered or granulated condition and therefore offers too high resistance. Also, these stones contain a certain amount of binding substance which is of high resistance.

Tuning Transformer

Question.—Why does the secondary of a tuning transformer slide inside the primary instead of the primary sliding inside the secondary as in a spark coil?—C. F., Little Valley, N. Y.

Answer.—These transformers generally have a sliding contact on the primary windings so that very close adjustment for any wave length can be obtained. Sufficiently close adjustment in the secondary circuit can be obtained by use of a switch and a variable condenser. The reason for the construction which you point out is that a slider can be more easily manipulated on the outside coil. The other method of construction could be used, however.

Aerial; Set Connections; Ground

Questions.—(A) Would No. 14 aluminum wire make a good aerial? (B) Please give connections for a fixed condenser having three binding posts, double slide tuning coil, potentiometer, 1,000-ohm receiver, electrolytic detector and batteries. (C) Would a pipe four feet long driven into the earth make a suitable ground for receiving?—A. H. L., Toledo, Ohio.

Answers.—(A) Yes.

(B) Referring to diagram 4, page 553, of the October, 1910, issue, the fixed condenser is shown at (C). Any one of the three binding posts may be connected to the lower slider of the tuning coil and to the earth, and either one of the other two binding posts may be connected to the detector and to the slider of the potentiometer as shown.

(C). Yes, for short distance working, that is, up to 200 or 300 miles. A longer pipe would give better results, since it might strike moist earth.

Receiving Radius

Questions.—(A) Please give receiving radius of the following outfit: Bare point electrolytic detector, 2,000-ohm phones, receiving transformer, potentiometer, variable condenser and fixed condenser. The aerial consists of four wires 60 feet high and 50 feet long. (B) Would a common tuning coil give as good results as one of the loose coupled type? (C) What instruments will increase my receiving range?—A. C., Belvidere, Ill.

Answers.—(A) About 600 miles over level land or water, receiving from high power commercial stations.

(B) A straight tuning coil will give nearly as great a receiving radius, unless there is interference, when a loose coupled tuner would give better results. This latter is nearly always the case.

(C) You would have somewhat better results with a good Perikon detector.

QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers: the full name and address of the writer must be given.

Polarity of Compass Needle

Question.—What is the polarity of the "north-seeking" pole of a compass needle and why is it called "north-seeking"?—H. E. S., Los Gatos, Cal.

Answer.—If the north-pointing pole of a needle is attracted by magnetism near the North Pole of the earth we must infer according to the law of magnetic attraction that the earth's magnetic North Pole and the north-pointing pole of the needle are unlike poles. If we call the magnetism at the North Pole "north" magnetism then the north-pointing pole of the needle is south magnetism. On account of confusion in this matter Sir William Thomson calls the north-pointing pole a "true south pole," although common practice is the opposite, calling it the north pole. The French and Chinese call the north-pointing pole of a needle a south pole and the south-pointing pole a north pole. The term "north-seeking pole" seems to avoid a misunderstanding as to which end of the needle we refer.

Commutator Troubles

Questions.—(A) What is the cause of high mica on the commutator of a motor? (B) What remedy can be applied? (C) Why do carbon brushes on a motor become pitted?—F. W., Chicago.

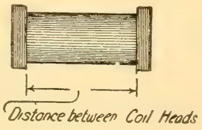
Answers.—(A) The raising of the mica is an unusual occurrence and does not take place over the entire commutator. What really does happen, is the wearing away of the copper bars leaving the mica projecting from between. In a poor machine this wearing away is not surprising. If the commutator is allowed to continue in its roughened condition the machine will flash over from one brush to the next and will act very badly under a heavy load.

(B) One way of getting the commutator into shape is to use the motor where the load is variable. While the motor is running light the brushes smooth up the commutator and thus counteract to a certain extent the bad results from a heavy load. A second remedy is to replace the commutator by another while a third treatment is to cut down the mica, with a narrow sharp chisel, 1-16 of an inch below the level of the bars. This last remedy is considered a good one.

(C) This may be due either to poor design or a wrong position of the brushes on the commutator. In design if the width of the brushes is not correct pitting will occur. In some cases where heavy current flows through the brushes they glow but this current is not all line current. The brushes overlap two segments of the commutator and so short circuit two coils of the armature. While in this condition if stray flux from the pole tips passes through the coils a very heavy current for the moment may be produced and glowing and pitting occur.

Distance Between Coil Heads

Question.—Referring to an induction coil, what is meant by "distance between coil heads?"—R. H. T., Greenville, S. C.



Answer.—See illustration.

Watts Per Candlepower of Filament Lamps

Questions.—(A) How many watts per candlepower does the carbon filament lamp require? (B) Tantalum? (C) Tungsten?—F. E. K., Asbury Park, N. J.

Answers.—(A) 3.5 watts.

(B) 2. watts.

(C) 1.25 watts.

Surrender and Re-Issue of Letters Patent

By OBED C. BILLMAN, LL. B., M. P. L.

RIGHT TO SURRENDER AND OBTAIN REISSUE.—*In General.*—Whenever any patent is inoperative or invalid by reason of a defective or insufficient specification, or by reason of the patentee claiming as his own invention or discovery more than he had a right to claim as new, if the error has arisen by inadvertence, accident, or mistake, and without any fraudulent or deceptive intention, the commissioner must, on the surrender of the original patent and the payment of the duty required by law, cause a new patent for the same invention, in accordance with the corrected specification, to be issued for the unexpired part of the original patent. The statute is to be construed liberally and not strictly as restraining and limiting the right.

ERRORS OR DEFECTS AUTHORIZING REISSUE.—*In General.*—A patent may be surrendered and a reissue granted only for the errors or defects specified in the statute.

INSUFFICIENT DESCRIPTION.—Where the specification of an original patent is defective for not containing a full and perfect description of the invention intended to be patented, the defect may be remedied by a reissue with a corrected specification.

ERRORS OF PATENT OFFICE.—Where the error is one of the patent office and not chargeable to the patentee, it may be corrected by a reissue.

CLAIMS TOO NARROW.—Where the claims are too narrow to cover the actual invention made and described and intended to be claimed, the defect may be cured by a reissue of the patent with broadened claims. But this can be done only where the original specification and description, including the drawings or model, sufficiently describe the actual invention, so as to show that the reissue is not in fact for a different invention, for the original and the reissued patents must both be for the same invention.

BUT MERE SUGGESTIONS IN THE ORIGINAL specification, drawings, or model will not be considered as a part of the invention intended to be covered by the original patent, unless it can be seen from a comparison of the two patents that the invention which the original patent was intended to cover embraced the things thus suggested or indicated, and unless the original specification indicated that those things were embraced in the invention intended to be secured by the original patent.

CLAIMS TOO BROAD.—Where the claims of a patent are too broad and include matter which the patentee had no right to claim as new, the defect may be cured by a reissue. But a reissue is rarely resorted to simply to cure excessive claims, as a simpler remedy exists by disclaimer.

CONDITIONS OF REISSUE—INVALIDITY OR INOPERATIVENESS OF PATENT.—It is only invalid or inoperative patents that may be surrendered and reissued. A valid and operative patent cannot be reissued solely for the purpose of expansion. But this must be taken with the qualification that a patent which is not valid and operative to the full extent of the actual invention described and intended to be claimed may be reissued so as to cover the real and actual invention. Such expansion, though not expressly authorized by the statute is deemed within the equity of the statute. But whether the right to such an expanded reissue of patents not wholly invalid or inoperative rests upon the statute or not, the right to and the validity of such reissues are now firmly established by the courts.

INADVERTENCE, ACCIDENT, OR MISTAKE.—A reissue is unauthorized unless the defect sought to be cured arose from inadvertence, accident or mistake.

INTENTIONAL OR FRAUDULENT DEFECTS.—Where the defect was intentional or fraudulent, it cannot be cured by a reissue.

PERSONS ENTITLED TO REISSUE.—*Where There has been No Assignment* of the patent, the sole right of surrender and reissue is vested in the patentee, or, if he is dead, in his executor or administrator.

If the Patent Has Been Assigned, the right of surrender is in the assignee. Where there has been an assignment of an undivided interest in the patent, the assignee and patentee or his legal representatives should join in the surrender. The patentee cannot, by a surrender, affect the rights of third persons to whom he has previously passed his interest in the whole or a part of the patent, without their consent. But the grantee of an exclusive territorial right or a mere licensee, need not join in the application for a reissue.

Reissues of Reissued Patents.—There may be more than one reissue of the same patent. Reissues are favored where the patentee is more specific or more modest in his claims.

NEW BOOKS

Motor Troubles. By E. B. Raymond. New York: McGraw-Hill Book Company. 1909. 197 pages with 98 diagrams and illustrations. Price $1.50.

The fact that the author is an electrical engineer in the motor line for the General Electric Company makes his experience especially valuable. New apparatus from an electrical manufacturing company is expected to operate from the first without difficulty and in order to assure this, tests must be made and any troubles remedied before the apparatus leaves the factory. The titles of the four parts into which the book is divided are: Part I. The Tracing of Direct Current Motor Troubles and Their Remedies; Part II. The Tracing of Alternating Current Motor Troubles and Their Remedies; Part III. The Testing of Direct Current Machinery; Part IV. Testing Alternating Current Machinery.

Flying Machines. Construction and Operation. By W. J. Jackman, M. E., and Thos. H. Russell, A. M., M. E., with an introductory chapter by Octave Chanute, C. E. Chicago: Chas. C. Thompson Company (Not Inc.). 1910. 221 pages with 94 illustrations. Price, cloth, $1.00. Flexible leather, $1.50.

This book is intended to give the reader interested in aerial navigation, practical instruction in the building and operation of flying machines. It is written in a non-technical manner and tells clearly of the principles as well as of the practice of the art of aviation.

The Story of Great Inventions. By Elmer Ellsworth Burns. New York: Harper and Brothers. 1910. 246 pages with 119 illustrations. Price, $1.25.

The purpose of this book is to tell in simple language how our great inventions came into being, to depict the life-struggles of the men who made them and in the telling of the story, to explain the working of the inventions in a way the boy can understand. The stories are so woven together as to give to the young reader a connected view of how our great inventions have arisen out of scientific discovery on the one hand and social and economic conditions on the other. This well written romance of great inventors will appeal strongly to young readers as well as to many older ones.

The Tesla High Frequency Coil, Its Construction and Uses. By George F. Haller and Elmer T. Cunningham. New York: D. Van Nostrand Company. 1910. 119 pages, with 56 illustrations. Price, $1.25.

After a careful study of a twelve-inch spark coil the authors set forth in this book much information designed to save the builder of a Tesla coil time and trouble over details. One chapter of fourteen pages, is given up to the uses of the coil for lighting vacuum tubes, Roentgen ray work, etc.

Dyke's Automobile Encyclopedia. By A. L. Dyke,: St. Louis, Mo.: A. L. Dyke. 1911. 407 pages with 148 pages of illustrations. Price, $3.25 prepaid.

The book is divided into 29 parts and treats of everything apparently pertaining to the construction, repair and operation of automobiles and gasoline engines. A marked feature of the book is the inclusion of a large number of illustrations lettered and arranged to convey a clear idea of the apparatus under consideration.

Electricity Experimentally and Practically Applied. By Sidney W. Ashe. New York: D. Van Nostrand Company. 1910. 349 pages with 422 illustrations. Price, $2.00.

After a concise presentation of the intimate connection between magnetism and electricity and a brief summary of the theory of direct current apparatus, the author illustrates and describes the more important types of primary and storage batteries, the action of electrolysis, the three-wire system, electrical measurements, motors, lamps and meters.

Physics. By Charles R. Mann and George R Twiss. Chicago: Scott, Foresman and Company. 1910. 417 pages witn 220 illustrations Price, $1.15.

This book is written for use as a text book in secondary schools. It is designed to take up the subject by the "problem method," that is, by seeking to answer queries with experiments and laboratory exercises.

ON POLYPHASE SUBJECTS

Electrical Training that Brings Success

The young man who is now in a technical school preparing himself for the electrical engineering profession will do well to gain also as much knowledge of metallurgy and chemistry as his time will permit. That electrical science owes much of its progress to research work done in metallurgy is well shown by the improvements made in transformer and armature iron which takes us back to the blast furnace where the iron first starts on its preparation and in which processes both the metallurgist and chemist are concerned. Further evidence of the inter-relation of these sciences is exemplified in the production of metals of high melting point for metallic high-efficiency lamps, which offers an unlimited field of research for the electrical engineer who is thoroughly equipped with a knowledge of chemistry and metallurgy.

Heating Up a River

In the great Fisk Street Station of the Commonwealth Edison Company of Chicago the steam turbines which drive the electric generators exhaust the steam, after most of the energy is taken out of it, into huge condensers. To condense this exhaust steam quickly, water from the Chicago River is pumped into the condensers, and, after having performed its duty in condensing the steam is discharged back into the river—this time as steaming hot water.

It is surprising, even to engineers, to learn in this connection that one-tenth of all the water in the Chicago River flows through the condensers of the Fisk Street plant, and in so doing drops half a million dollars of the company's money right into the river each year, in the form of wasted heat units. But there seems to be no economical way of getting around this serious leak.

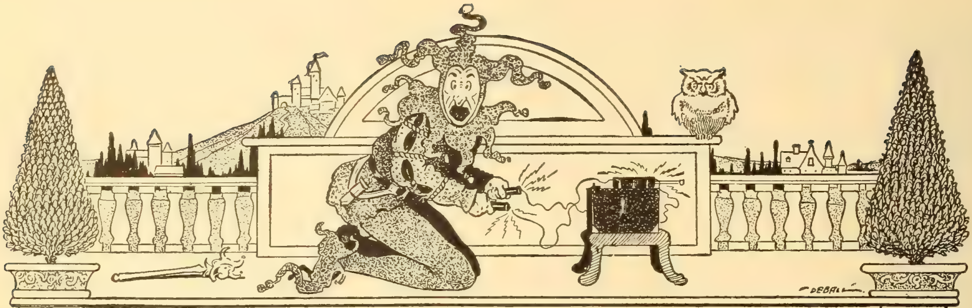
The Quarry Street Station which is situated just across the river from the Fisk Street plant, shunts five per cent of the river's flow through its condensers.

The Economy Light and Power Company, a small competitor down river from the Commonwealth stations used to have a lot of trouble in the winter with ice in the river. Since the big plants have so graciously taken to warming up the river, however, no ice trouble has occurred on the river and sanitary canal, not even as far down as the hydro-electric plant of the Sanitary District, 25 miles below.

Locating Pearls with X-Rays

The pearl fishing industry of Ceylon has long been noted as an example of the tremendous waste which too often accompanies primitive methods. Hauling the pearl oysters into boats and opening them to sort out the comparatively few containing pearls, has always meant the needless killing of hundreds of thousands of these mollusks and the polluting of both water and air through their decay.

Six years ago one of the authorities on all forms of animal life in the deep seas, Prof. Robert von Lendenfeld of the Zoological Institute at Prague, recommended the use of Roentgen rays for determining whether or not the unopened bivalves contained pearls. Now at last the suggestion has been put into practice and the unopened shells are tested at the rate of about 100 per minute on board a steamer to which they are brought partly by dragnets and partly by men in regulation divers' outfits. The X-rays readily indicate whether or not pearls are present and those containing none are thrown back into the water. Those showing the presence of small sized pearls are taken to secluded spots near the shore where they are left in the water while the pearls develop to a marketable size. Only those shells in which the X-ray radioscope shows pearls of considerable size are opened and robbed of their valuable contents, thus saving both the time of opening the many others and the ruthless slaughter of the majority of the mollusks, some of which may still secrete pearls later on.



SHORT CIRCUITS

A crowd had gathered to see the first car on a new line make its initial trip. A great deal of preparatory work seemed to be required by the motorman, and, as the people stood and watched every movement, a pessimistic old lady, to whom the idea of a car being able to move without any visible propelling power was incomprehensible, kept remarking, "It'll never go. It'll never go."

Finally everything was adjusted to the motorman's satisfaction. He turned the switch, and the car sped away down the track.

The old lady's eyes opened wide. She watched the car far a moment, and then, with amazement still written upon her features, but with firm conviction in her voice, she turned once more to the crowd and said, "It'll never stop!"

* * *

Mrs. Subbubs—Henry, that's twice you've come home and forgotten to bring the lard.

Subbubs—Yes, my love, it's so greasy it slipped my mind.

* * *

A youth from Calhoun county, Ill., which has nothing but steamboat transportation, came over to Elsberry, Mo., the other day to catch a Burlington train to St. Louis.

He had never seen a train, and when the Hannibal local came rolling in he stood there gaping, watched it hiss and steam, and finally pull out.

"I thought you was goin' to St. Louis on that train?" shouted the station agent, thrusting his head through the window.

"I was," answered the youth, "but they didn't put down no gangplank."

* * *

"What's the hardest thing about roller skating when you're learning?" asked a hesitating young man of the instructor at a rink.

"The floor," answered the attendant.

* * *

A newly-wed desired this to be inserted: "Love is the electricity that lights up the soul; marriage, the switch by which it is turned on or off."

* * *

George Ade was presiding at a banquet one night. In introducing each speaker he made some reference to the etymology of the speaker's name and pointed out some alleged definition of the name based upon an imaginary Latin or Greek derivation.

By and by the humorist himself was to speak, and another member of the party introduced him. "The next speaker will be Mr. George Ade," said the man. "Now, let us consider that word Ade. It comes from the old French source, aide, or, in modern English, aid, meaning help, assistance. It also means succor."

* * *

The young lady bad been a great traveler in the West. "Been in California, Oregon, New Mexico, and Duluth, I suppose," inquired the man. "Yes, indeed, I've seen most every thing in the West," she vaunted. "Ever see the Cherokee Strip?" "N-no," with reddening face, "b-but they do almost."

A little Scottish boy was up the other day before the examiners for the Navy; the examination was *viva voce*, designed to discover signs (if any) of "general intelligence." They asked the boy what he knew about the battle of Flodden. He said, "Nothing." "What!" they said. "Don't you know anything about that battle in which the English beat the Scotch?" "Well," he said, "I know it must have been verra exceptional."

* * *

"Show me one of these old robber castles of the Rhine," commanded the tourist.

"Robber castles?" echoed the puzzled guide. "Does the gentleman mean a garage?"

* * *

St. Peter (to applicant)—What was your business when on earth?

Applicant—Editor of a newspaper.

St. Peter—Big circulation, of course?

Applicant—No, small; smallest in the country.

St. Peter—Pick out your harp.

* * *

Papa—Where have you been, James?

"Fishin'."

"Come into the woodshed and we'll have a whaling expedition."

* * *

The wild beasts gnashed their teeth and roared like a circus calliope; the gladiators shouted hoarsely; the arena was knee-deep with gore.

In the amphitheater the pleasure-seeking populace clamored tumultuously

"More blood! More death!" they yelled ferociously.

Great Caesar in his private box heard their cry and sighed.

"Would that I might grant their prayer," he muttered. "If only—" and imploringly he raised his eyes heavenward—"I could pull off an automobile cup race!"

Great Caesar wept.

For with all his boasted power he was unable to hasten the flight of time.

* * *

Little Walter was always carefully guarded against germs. The telephone was sprayed, the drinking utensils sterilized, and public conveyances and places were forbidden him.

"Father," he said one night, in a tone of desperation, "do you know what I am going to do when I grow up?"

"What?" asked his father, preparing himself for the worst.

"I'm going to eat a germ."

* * *

Earnest but Prosy Street-corner Orator—I want land reform; I want housing reform; I want educational reform; I want—

Bored Voice—Chloroform.

* * *

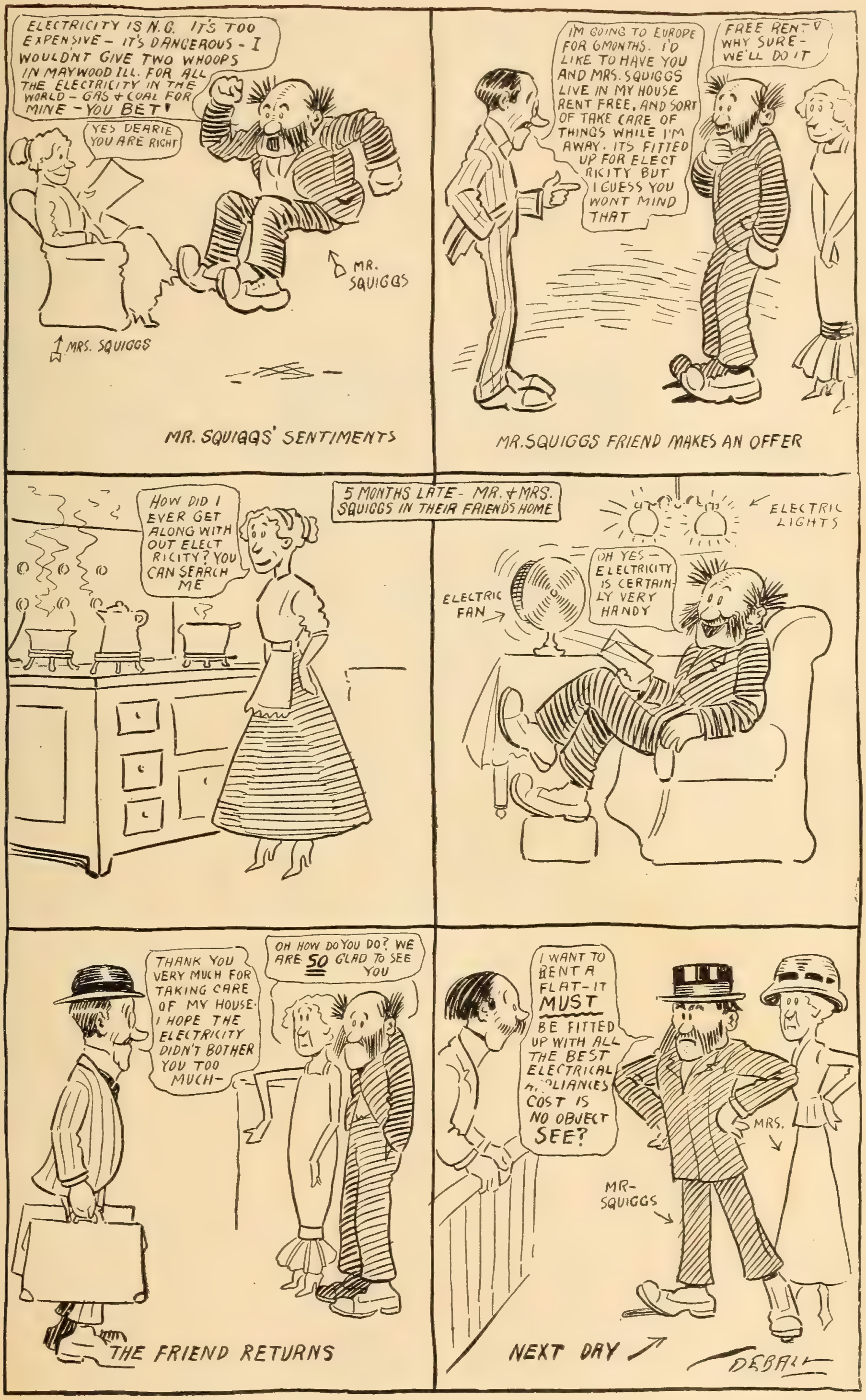
Small Girl (of twelve)—Is this a library?

Librarian—Yes.

Small Girl—I want something wicked and excitin and bad.

Librarian—I wouldn't let you have any book like that, little girl.

Small Girl—It ain't for me—I've read 'em. It's for my younger sister.

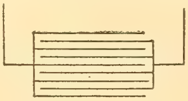

ELECTRICITY IS N.G. IT'S TOO EXPENSIVE - IT'S DANGEROUS - I WOULDN'T GIVE TWO WHOOPS IN MAYWOOD ILL. FOR ALL THE ELECTRICITY IN THE WORLD - GAS + COAL FOR MINE - YOU BET!
YES DEARIE YOU ARE RIGHT
MR. SQUIGGS
MRS. SQUIGGS
MR. SQUIGGS' SENTIMENTS
I'M GOING TO EUROPE FOR 6 MONTHS. I'D LIKE TO HAVE YOU AND MRS. SQUIGGS LIVE IN MY HOUSE RENT FREE, AND SORT OF TAKE CARE OF THINGS WHILE I'M AWAY. ITS FITTED UP FOR ELECTRICITY BUT I GUESS YOU WONT MIND THAT
FREE RENT? WHY SURE - WE'LL DO IT
MR. SQUIGGS FRIEND MAKES AN OFFER
5 MONTHS LATE - MR. + MRS. SQUIGGS IN THEIR FRIEND'S HOME
HOW DID I EVER GET ALONG WITH OUT ELECTRICITY? YOU CAN SEARCH ME
ELECTRIC LIGHTS
ELECTRIC FAN
OH YES - ELECTRICITY IS CERTAINLY VERY HANDY
THANK YOU VERY MUCH FOR TAKING CARE OF MY HOUSE. I HOPE THE ELECTRICITY DIDN'T BOTHER YOU TOO MUCH -
OH HOW DO YOU DO? WE ARE SO GLAD TO SEE YOU
THE FRIEND RETURNS
I WANT TO RENT A FLAT - IT MUST BE FITTED UP WITH ALL THE BEST ELECTRICAL APPLIANCES COST IS NO OBJECT SEE?
MRS.
MR - SQUIGGS
NEXT DAY
DEBALL

COMMON ELECTRICAL TERMS DEFINED

In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.

Compound Wound Motor.—A motor with two field windings, one in series with its external circuit and armature, the other in parallel or shunt with the armature. (See Compound Dynamo.)

Condenser.—A device for storing up static charges of electricity by induction. Tinfoil sheets separated by paraffine paper, mica or glass are alternately connected to two leads. These leads may be connected across a circuit, or one to a positive terminal, the other to ground. A condenser increases the capacity of a circuit. (See cut.)



Condenser, Adjustable.—A condenser in which the capacity may be varied as desired.

Condenser Coatings.—The sheets of tinfoil or other conducting material which make the surface of the condenser able to receive and part with an electric charge. Often applied to the tinfoil of a Leyden jar.

Conductance.—A word sometimes used instead of conductivity.

Conductive Discharge. A discharge of electricity through a conductor, as when a continuous current flows from the positive terminal through the external circuit and back to the negative terminal.

Conductivity.—The property of a substance which allows it to pass an electric current either poorly or well. The greater the resistance of a given material the less its conductivity, therefore conductivity is often stated as the reciprocal of the resistance or $\frac{1}{R}$. Matthiessen established a standard for finding the resistance of copper using the formula: $R = \frac{10.35 X L}{D^2}$, R being the resistance in ohms at 68° F., L the length in feet and D the diameter of the wire in mils. It is possible to obtain copper purer than that used by Matthiesen but commercial copper falls below this standard.

Conductor.—In electricity a substance which will permit the passage of a current of electrictiy. Silver and copper are good conductors while glass is a poor conductor.

Conduit.—Ducts or piping of metal, tile, paper or other material within which are run electric wires, these ducts or pipes being made for use either in buildings or in underground work.

Connector.—Any device for joining the ends of two or more wires.

Consequent Poles.—If a bar magnet be so magnetized as to have both ends of the same polarity and the middle of opposite polarity the magnet is said to have two consequent poles.

Constant Current.—A current which flows continuously for some time without any variation in amperes. A series arc system is operated by a steady or constant current.

Constant Current Alternator.—An alternator designed to supply an unvarying current. Used on series lighting and series arc systems. The voltage rises or falls as more lamps are added to or cut out of the circuit the current remaining constant.

Constant Current Circuit.—A circuit in which the number of amperes remains constant without regard to the changes which may occur in its resistance.

Constant Current Regulator.—A device for maintaining constant the current from a dynamo when changes in the resistance of the external circuit are made. The Brush regulator, for example, does this by having across the field magnet coils a shunt whose resistance may be varied by an electromagnet energized by a coil through which the main current flows.

Constant Potential.—The ordinary system of incandescent lighting in which the voltage is kept constant between any two wires. The current increases or diminishes according to the demand.

Constant Potential Regulator.—An automatic device consisting of a rheostat in the shunt field circuit of a generator, the moving arm of the rheostat being operated by a solenoid in such a way as to vary the field circuit current by varying the resistance and thus keep the generator voltage constant.

Contact Breaker.—A device operating either automatically or mechanically to break and make a circuit.

Contact Point.—A point or pin often made of platinum against which a spring or other surface is brought to close an electric circuit. Used on coils, telegraph keys, etc.

Contact Maker.—A device for making electrical contact thus sending current to instruments during a test. It usually consists of a wheel upon the rim of which at regular intervals are copper strips. Between the strips the rim may be of hard rubber or other insulation. As the wheel revolves these contacts close the circuit through a copper brush resting on the circumference of the wheel, the frequency of the contact being governed by the number of revolutions per minute of the wheel. Used in connection with tests of generator armatures

Contact Series.—If different metals are brought in contact, a certain potential difference is developed. For example, if a piece of zinc be placed against a piece of lead the zinc is positive to the lead by .21 volt. An arrangement of substances on this basis is termed a "contact series." Volta recognized this by framing a law covering the condition.

Contact Spring.—The metal spring attached to the armature of the vibrator in a bell or in an induction coil, by which the circuit is made and broken against the platinum point of the adjusting screw.

Continuous Current.—Current which flows in one direction only.

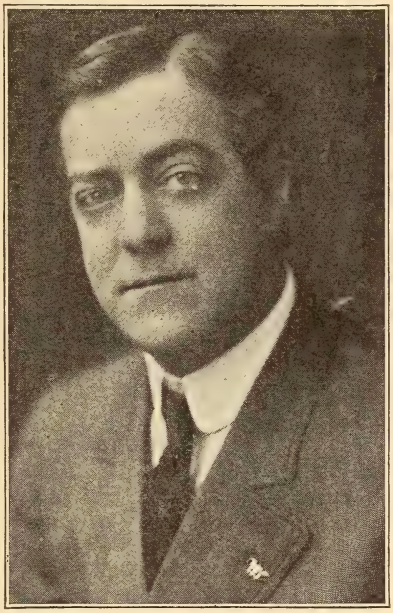
Continuous Rheostat.—A device for carrying current continuously up to a certain limit without changing its resistance. Used in measuring current by the fall of potential method which is based on Ohm's law transposed; $E = C \times R$.

The Man Who Made Florida

A TRUE STORY OF THE FIRST MAN OF THIS DECADE TO DEMONSTRATE THE PRACTICAL VALUE OF FLORIDA AS THE HOME OF "TEN ACRES AND LIBERTY"

By E. C. Roy

This reads like fiction but it is nothing but fact. I have traced the influences which have created the tremendous land rush to Florida, and though my opinion may be an humble one I give it to you for what it is worth.



CHARLES H. SIEG
The man who made Florida famous as the Poor Man's Paradise

I say without fear that the very first man to prove to the world that Florida was a spot where the man of ordinary means could be forever secure from loss of livelihood was and is Charles H. Sieg.

This man had made a minute and a careful study of the trend of the public mind. Three years ago he saw the "back-to-the-land" idea coming.

He was a man who has devoted much of his life to the manufacturing of mechanical things. He was successful and more than all else he was carefully practical.

He learned that the most essential thing in all agricultural topics was climate. He made a thorough study of crop failures, and the figures he can give to you on this subject would alarm you. He traveled much and read more. He conversed with many of the best informed men in this country on land.

Out of his own deductions there arose the determination to give Florida the test of fire. He wanted proof and proof only after a complete test.

All over this state he went. Into the swamps of the south, down upon the wet prairies bordering the Caloosahatchie he went, along the west coast and into the great districts of the middle ridge of Florida. He learned the state. He slept with the timber buyers, the land cruisers, the hunters, the cane and corn planters, he learned of riches by nights spent with the growers of grape fruit and oranges. He fished the streams and his gun brought down the feathered treasures of the pines and palmettoes. He bathed in crystal waters during the winter months. He learned what "the out of doors" means in Florida and mentally he made a note of all these things.

When these places were as familiar to him as our own scenes are to us he began the idea that I claim has made Florida the most talked-of and read about spot in the entire world.

He purchased thirty-six thousand acres bordering beautiful Crescent Lake in St. John's County. He told of the tests he had made. He offered this land to the public at the rate of less than two good cigars a day. Financiers said: "Mr. Sieg, you cannot make a success when you sell land at such small terms." The announcements appeared in the public press and every acre of this 36,000-acre tract was sold out in less than thirty days. He had more than 1,500 applications which could not be filled. Again he bought land. This time he had the prestige of the St. John's Park Colony behind him, and when he offered the second colony for sale, the name of which he called it was Jacksonville Heights Colony, he sold this project out in the same time that he consumed to dispose of St. John's Park. Then he began to see to the detail of the actual settlement, for Mr. Sieg is practical in everything he does. He is not a land man. The company he is president of is not a land company. It does not abandon its settlers to their own resources. It builds roads, helps teach the essential lessons, operates experimental farms and sticks close to the new colonist until, like the young bird, he is ready to fly and can take care of himself. Now comes the point that I say proves this man Sieg to be the father of the Great Florida land-rush. The success of these two colonies spread over this country like wildfire. The newspapers began to quote Florida topics. The doctrine of Sieg had sunk deep into the innermost recesses of the minds of the men who had influence and brains.

They knew that a land where there was the climate which could produce three crops every year, where the gentle breezes from the sea swept first in one direction and then in another over this land, was a spot where man could do three times as much with land than he could do in the great West or upon the sterile farms of the East. These financial giants who had robbed Florida of her trees and her turpentine, who had sought after the phosphate in her mines to enrich the lands of other farming sections, who had made millions in her fisheries, these men now saw that Sieg had struck the real riches of this great state and that their efforts were as nothing compared to the wealth that lay upon her fertile plains for the farmer and fruit grower.

DEPOT INTERLACHEN. A SMALL CITY ON THE FLORIDA-PALATKA COLONY

These men came to Florida. Not in pairs but in droves. They scurried all over the state. They bought land and they copied Sieg's ideas and his arguments. They had learned that land could be sold on the easy-payment plan, so they began to advertise. In just a few brief months there was a tremendous land rush toward Florida. Almost every train headed toward the south bore some man or woman to Florida.

All this was a little over two years ago. Last fall Charles H. Sieg started his third great colony. He had by this time solved many perplexing questions and knew better what to do and how to do those things which meant more for the comfort of his colonists. This colony he called Burbank Ocala and he located it down in that portion of Florida where the ancient Seminole Indians had lived and chose to call it "The Land of Plenty." You cannot imagine this spot unless you have been to Florida and know the charm and beauty of its pregnant interior.

This colony was located 101 miles south of Jacksonville on two railroads. In a short time, 90 days in fact, this entire tract of 65,000 acres was sold out. A railroad company, realizing the prestige and profit such a colony meant, began to build a line through its very heart from the pretty city of Ocala to the great St. John's River port, Palatka. This railroad at once made Burbank Ocala Colony a definite and fixed show-place of the entire state. Here the colonists came by the hundreds. They came dressed in all manner of clothes. Some there were who had left the Saskatchewan and the dreary winters and the toiling days in the wheat fields; others came from the cities of the Northeast and West. Here met for the first time the doctor and the office manager, the expert mechanic and the Yankee school teacher, and the Western farmer and the railroad engineer. They were followed by their wives and their children. In a short time their land was cleared. Their houses began to show through the beautiful pines and live oaks. They planted their crops and tilled their fields. Two towns sprang up in the short space of five brief months. Everywhere one looked there was improvement.

You should talk with some of these people if you want to know what all this means.

The work of Charles H. Sieg was bearing better and bigger fruit. His company had work to do and it did it. They made roads, built administration buildings, dug ditches so the excess rainfall of the summer would work no hardship. They put in an experimental farm. They attracted competent merchants and in every possible manner supported their colonists as far as it lay in their power to do so. This colony is now a tremendous success, and it is because of this success that Mr. Sieg has been compelled to secure additional land lying alongside of the Burbank Ocala colony to supply the demand that has been made upon him for small farms from people located in almost every section of this country, some even coming from European points.

If you would admire the other colonies which he has fathered and which are to-day eminently successful you would be wildly enthusiastic over the latest and best colony which he is colonizing now, called the Florida-Palatka Colony.

There is no spot on the North American continent where nature and man have joined together so successfully for the luxurious abode of humanity. This great colony, whose lands today are selling so fast as to be almost unbelievable, is located in the major part of Putnam County, though some lies in Page and Marion Counties. These three counties rank the first in the state and have repeatedly taken the blue-ribbon prizes at state fairs and exhibitions because of the excellence of the agricultural and horticultural products. Florida-Palatka Colony occupies the highest land in the state of Florida. This is an element you should have in all Florida land, for it means safety to your home and crops when the heavy rain floods the low lands, as the case often is in some portions of Florida.

ST. JOHN'S RIVER SKIRTING FLORIDA-PALATKA TRACT

Then this great colony is located upon the very best of excellent railroads. You can get out of a Pullman car directly upon this land. The Atlantic Coast line, the Seaboard Air Line, the Florida East Coast, the Florida & Georgia Southern, and the Ocala & Northern railroads are all available for this colony's needs. You can have the very best passenger and freight service.

At one side of the colony flows the mighty St. John's River, broad as a bay and deep enough to permit sea-going vessels to dock at Palatka, which city is but ten miles from a portion of this colony. Down this great river lies Jacksonville, the fastest-growing city in the South, if not in the Union. You may enjoy the best churches, the finest schools, the best roads and the most select society in and around this colony. You will have a superb home for health's sake, for the death-rate here is less than 7 in 1,000, a record no other state in this country can approach.

If you want to be charmed and entranced with the grandeur of sky and landscape, if you want to be thrilled by wonderful color schemes, as nature makes them, and if you wish to listen to the wild and delightful music of the wonderful mockingbird, and see the wild duck and the artful quail and turkey feeding along the beautiful waterways, then here is the spot of spots for you to make a home. Every day of the year is a holiday for the settlers of this land. The streams are filled with the very best fishing one could wish for. The woods are teeming with squirrel, fox, rabbit and other small game, while within a few hours' ride one can yet get a proud pair of antlers and have venison for one's table. On one side of the colony flows the Ochlawaha River. This stream is without question the most romantic and picturesque in this country. No matter what manner of natural beauty you desire you will find it here. The river is swift-flowing. It is lined on either bank by gigantic pines, palmettoes, cypress, and live oak. These beautiful trees are draped with Spanish moss, just as though some master-hand at festooning had been here before one to please every sense of the artistic. The bosom of the river is one mass of fanciful colors and weird shadow-effects that travelers pronounce without an equal anywhere in the world.

The beauty of this spot is above question. No one can look upon it and remain unmoved.

It is abject folly to attempt to describe this beautiful region, where Mr. Sieg has selected the last and only colony perhaps he will ever be the moving spirit in. Just consider what it all means to have a home here. Not only does one enjoy the very pinnacles of nature's greatest unimproved gifts beside one's very door step; not only is your home at once a health resort and a playground for the grown-up boy and girl, but you have all around you, within a short hour or more ride, all the joys of the deep sea, the unfolding charm of the government reservation, where a giant forest will remain untouched throughout all the ages for the rambling ground of man and the wild animals and the full-noted Southern wild birds. Then, too, you have elegant cities but a short distance away where you may go and shop, or if you please, attend the opera or the theater and see the latest dramatic successes.

MR. KENNERLY RAISED 600 CRATES OF SUCH CELERY ON HALF ACRE OF ORDINARY PINE LAND NEAR FLORIDA-PALATKA COLONY

This sort of thing is life in all the word means and implies. To the worn-out man of the cities it is more than life; to the farmer it is all play, and he cannot comprehend it until he sees everything with his own eyes. Speaking of this question, the farmer revels in a perfect ecstasy when he learns the producing value of this great soil. Let me briefly tell you something of the soil which lies universally over the Florida-Palatka Colony.

The land you buy has a very peculiar soil. It is a rich, sandy loam underlaid by a heavy and deep clay subsoil that has the color of chocolate and is the part of the soil that holds the water that is drawn up gradually through the peculiar sandy loam by the action of the sun's rays and the needs of plant-life. This clay subsoil acts as a true and natural storehouse for moisture right at the roots of the plants and the trees, where water is needed.

The earning ability of this land is unlimited. This is the home of the three-crop farmer. It is here that now this very day the farmers and growers are working in their fields in their shirt-sleeves. They will within a few weeks be sending their third crop to market, and this just at the time when the prices are the very highest and when the whole farming country of our Union is idle, except Florida and some of the far-distant points, like Texas and California.

There are men in these counties who earn $1,000 per acre, and there are men who earn only $100 per acre. The average value of all Florida crops per acre is $125, as is shown by the state and government agricultural reports. Much depends on the man and his ability and desire to work.

The Northern men are the ones who are making $1,000 per acre; the native and the negro are the ones who content themselves with the lesser amount.

If you desire to go in for oranges, grape-fruit, pecans and other tree products, one can reach a yield per acre that is simply astounding.

The majority of settlers are planting garden-truck, ground-fruits, etc., and the prices on these products are such as to raise a figure per acre that will satisfy almost any man or woman, for each acre produces that figure three times each year.

I have been to most all of the so-called garden spots of Florida. I have talked with the great fruit and vegetable growers whose life work has been devoted to various sections of this state. I have visited their home and met their families. I have walked into their fields and amid their trees. These men would startle you with the statement of the profits they have earned in just a few years from just a few acres. Their bankers will tell you the same story. They own automobiles, they send their children to the best universities, they travel at home and abroad and every month of every year they are as independent of all mankind as though they received their competence from some source outside this universe.

It is folly, as I have said before, for one to attempt to tell of these things for the reason that most people will decry your wording and will remain sceptical until they have seen the proofs with their own eyes.

If you want to know more of the great Florida-Palatka colony and of the history of the colonies Charles H. Sieg has established, you should write for his great free book called "Ten Acres and Freedom."

This book contains more than 60,000 words. It is filled from cover to cover with photographs of colony scenes. It pictures with the camera, in plain black and white, the beauties of the countryside around this great colony.

It takes you out upon the St. John's River and down the fantastic Ochlawaha River. It shows you Silver Springs and Silver Lake, the new towns born this year over the colony; it reveals farm scenes and illustrates almost every point you would wish to know simply by the use of photographic reproductions.

HOTEL AT RODMAN—ONE OF THE TOWNS IN FLORIDA-PALATKA TRACT

It goes into the statistical side of Florida and of this colony in particular. It moves along with a rhythm of fact after fact compiled from the best state, government and expert reports obtainable and it never tires and never grows dull. It is almost like a novel, for everything is new and everything is written in a common, every-day style of language that carries conviction with it.

This great book tells you the prices of those things you wish to know. It informs you all about railroad rates, both freight and passenger. It tells you of Jacksonville and the other cities of Florida. It speaks of climate and shows you the proof from the Weather Bureau, covering something like twenty years, so that you may know just how far down the thermometer goes in the winter time and how far up it goes in the summer time. It proves to you that the North is a worse place to live in during the summer than Florida. It gives you facts that you can substantiate. It tells you of the health conditions, and how Florida has the lowest death-rate of any of our states. It describes Florida's advantages and Florida-Palatka Colony in particular from a transportation standpoint both by water and by rail. It gives you crop statistics and tells you what to plant and how to plant it, and estimates the cost of each and every transaction for you. It tells you what to do and how to do it, from the time you leave your home until you have your house built and your first crop in.

It contains all manner of testimonial proof together with the names and addresses of those colonists who have dealt with this great colonization company, and proves to you that their words are like their bonds.

This book, in my opinion, is the greatest piece of literature ever issued on any section of our country, and is another reason why Charles H. Sieg should be called "The Man Who Made Florida."

Then you will receive the monthly magazine called *The New Florida*, which tells of the development of Florida and contains the monthly news of Mr. Sieg's great colonies. This paper sells for one dollar a year, but will be sent free to any address for three months just for the coupon below.

By special provision the New South Farm and Home Company will send free to every one who sends in the coupon below all the literature above described, together with their written binding and legal guaranty to give every one who buys a colony farm 120 days to investigate his land, and if he finds it not what he desires, or if, for any other reason, he desires to cancel his contract he need only to request his money back within the time limit of 120 days and his money will be returned. It is needless to say that Charles H. Sieg knows from experience just what to expect from such a broadcast guaranty and that he has no fears from such provision because the land will protect him and please every purchaser. Remember you are buying land in a company that has proven its value; in one that is a community builder, and not a strict land-selling corporation. A company that has pleased thousands and can prove every statement it makes, or failing to satisfy you, it agrees to return your money. This is why I say that this company, and the man at its head, is the primal force in the making of Florida the most sought-after and talked-of state in this Union.

PUTNAM COUNTY COURT HOUSE, JUST BEING COMPLETED

The Price of Florida-Palatka Farms is $30 Per Acre; Terms

$5 down and $5 a month for 59 months buys a 10-acre farm

$10 down and $10 a month for 59 months buys a 20-acre farm

$15 down and $15 a month for 59 months buys a 30-acre farm

$20 down and $20 a month for 59 months buys a 40-acre farm

No Taxes. No Fees. No Commissions. All you have to pay is like above figures each month. We pay all taxes until you pay for your farm in full. You may have possession after the very first payment.

Every purchaser of a Florida-Palatka Colony farm will be permitted to receive every cent he has paid in, if for any reason he does not desire his farm, within 120 days from the date of his contract. This will give you ample time to make an investigation, or if you are not satisfied with the farm which has been allotted to you, you can exchange it for one entirely to your liking or know that you can receive back every cent you have paid in. No other company in Florida makes such an offer. This company does so because it does not fear the closest scrutiny into each and every phase of its colony.

Don't delay a single day. Send in the coupon now, today, this very minute, and receive the greatest descriptive literature you have ever read. Just send the coupon below—no letter is necessary.

NEW SOUTH FARM AND HOME COMPANY
ROOM 1071, MERCHANTS LOAN AND TRUST BUILDING, CHICAGO

Please send me "Ten Acres and Freedom" and a three-months' subscription to the New Florida Magazine. Everything is sent FREE. I don't agree to buy. I only want your literature.

Name.................................... *Address*....................................

City.................................... *State*....................................

Will You Try Johnson's Wood Dye and Wax at our Expense?

We'll gladly send you samples of all of Johnson's Wood Finishes—together with copy of our beautifully illustrated book by famous experts—printed in five colors—"The Proper Treatment for Floors, Woodwork and Furniture"—absolutely free. This Book tells you how to finish or refinish all woodwork, floors and furniture.

Read Free Offer Below.

Johnson's Prepared Wax

for all woodwork, floors and furniture (including pianos). Anyone can easily use Johnson's Prepared Wax over any finish or on the bare wood for that beautiful, artistic, dull finish so much in vogue. Ask your dealer for sample.

Johnson's Wood Dye

—not a varnish stain—but a deep-seated Dye which penetrates the wood and fixes a deep, rich, permanent color. Made in 14 artistic shades. Johnson's Wood Dye makes inexpensive softwoods as beautiful and artistic as expensive hard woods. Color plates and directions for use in the booklet.

Johnson's Kleen Floor

for cleaning all polished floors, stairs, and finished surfaces, keeping them in perfect condition. Apply with a cloth and rub dry—removes all stains and discolorations. After using, give the surface a coat of Johnson's Prepared Wax and the wood will look just like new.

Johnson's Under-Lac

a thin, elastic spirit finish far superior to varnish or shellac. Not thick or sticky or slow-drying like varnish—neither does it dry too quickly like shellac. Especially good on linoleums and oilcloth, bringing out the pattern and giving a finish as glossy as new. Protects from wear—makes cleaning easy. Dries hard in an hour. Gallons $2.50—quarts 70c—pints 40c.

Free Book and Sample Offer

Answer this ad and get this 25c book free.

We have sent a liberal supply of Johnson's Wood Finishes—together with a supply of our beautiful Instruction Book by famous experts—illustrated in five colors—to all leading dealers who handle paints, for your use, free. If your dealer hasn't samples and books send us his name, and we'll send you Free—any two of the above finishes, with copy of the Book. All we ask is that you test the samples and ask your dealer to supply your future needs.

S. C. Johnson & Son, Racine, Wis.
"The Wood Finishing Authorities"

Free Coupon

For 25c Book, "The Proper Treatment for Floors, Woodwork and Furniture" FREE and two samples as follows: ....

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Name ....

Address ....

Paint Dealer's Name ....

Paint Dealer's Address ....

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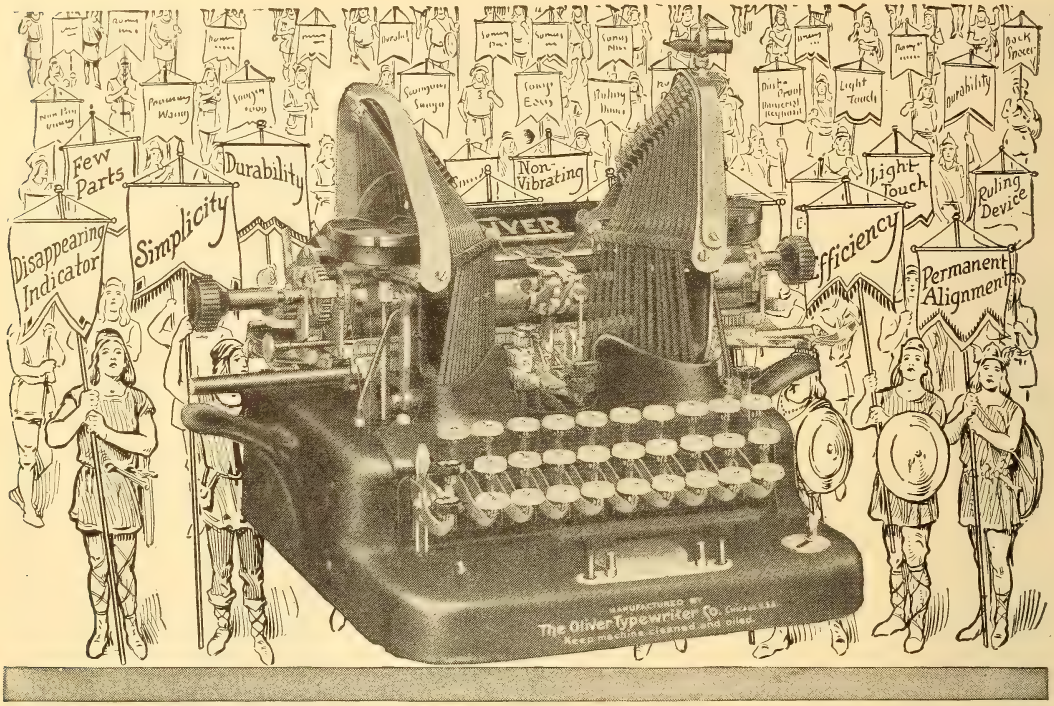


Backed by a Brilliant Array of

The Oliver Typewriter, which brought about the Era of **Visible Writing—a revolutionary improvement**—has persistently carried the standard toward the summit of Highest Efficiency. The many brilliant innovations that have been introduced in rapid succession, overturning typewriter traditions and precedents, have kept the Typewriter world in a ferment since the Oliver entered the field.

"Visible Writing," the central thought around which revolve these many startling improvements, encountered tremendous opposition from our staid, conservative rivals.

The OLIVER Typewriter

The Standard Visible Writer

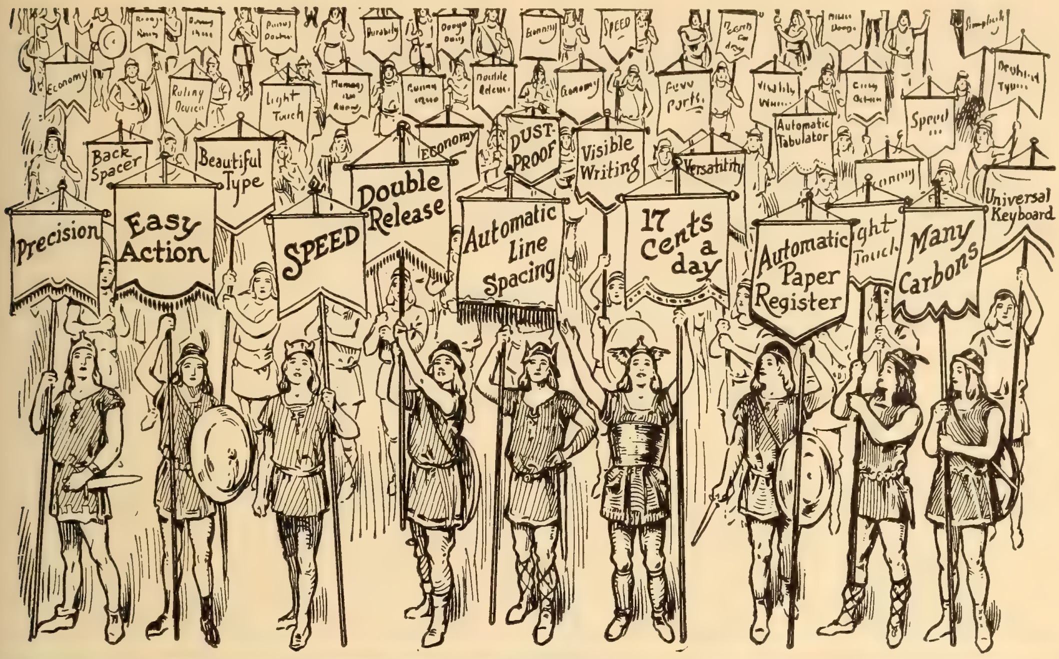
They thought to stem the resistless tide of popular approval by condemning it as "unnecessary," "impractical," "visionary." Then—one by one—these **"blind"** manufacturers ran up the flag of **surrender.**

Today—all standard typewriters are "Visibles"!

Do you wonder that the Oliver has the largest sale of any typewriter in existence?

Why not buy a typewriter that has—at the Present Time—all these time-saving, result-getting innovations, rather than one that will adopt them later, when forced to change by enlightened public opinion?

The Oliver Typewriter **17-Cents-a-Day Purchase Plan** is in its way as great an innovation as was that of **Visible Writing.** It extends the **immediate** advantages of the use of **Typewriters** to thousands who must otherwise **wait.** The response of the public to this amazing offer is **phenomenal.** Sales are reaching **stupendous volume.**



Oliver Typewriter Features!

The abandonment of **longhand** in favor of clean, beautiful, legible **typewriting** is the next great step in human progress. **The Era of Universal Typewriting is fast becoming a reality!** The Oliver Typewriter is just as indispensible to small merchants, tradesmen, shop and factory owners as to the largest business enterprise. It's an easy way for the merchant and tradesman to **protect** himself against **misunderstandings,** because he keeps a **carbon copy** of every typewritten letter or document. The **legibility** of typewriting prevents mistakes, disputes, delays. Professional people, ministers, authors—all who have to **write,** where typewriting would be more welcome to those who **read it,** owe it to themselves to own Oliver Typewriters.

Yours for 17 Cents a Day!

This "17-Cents-a-Day" Purchase Plan makes the Oliver Typewriter as easy to own as to rent. It places the machine within easy reach of every home—every individual. A "man's cigar money"—a woman's "pin money" will buy it! Clerks on small salaries can now afford to own Oliver Typewriters. By utilizing spare moments for practice they may fit themselves for more important positions. Schoolboys and schoolgirls can buy Oliver Typewriters, just by saving their pennies.

You can buy the Oliver Typewriter on this plan at the regular catalog price—$100. A small first payment brings the machine. Then you save 17 cents a day and pay monthly.

And the possession of an Oliver Typewriter enables you to earn money to finish paying for the machine.

Can you spend 17 Cents a Day to better advantage than in the purchase of this wonderful machine?

Write for handsome Catalog and 17-Cents-a-Day Purchase Plan. Address—Sales Department

The Oliver Typewriter Company

643 Oliver Typewriter Bldg., Chicago (77)

Send Coupon or Letter

The Oliver Typewriter Company
643 Oliver Typewriter Bldg., Chicago

Gentlemen: Please send your Art Catalog and details of "17-Cents-a-Day" offer on the Oliver Typewriter.

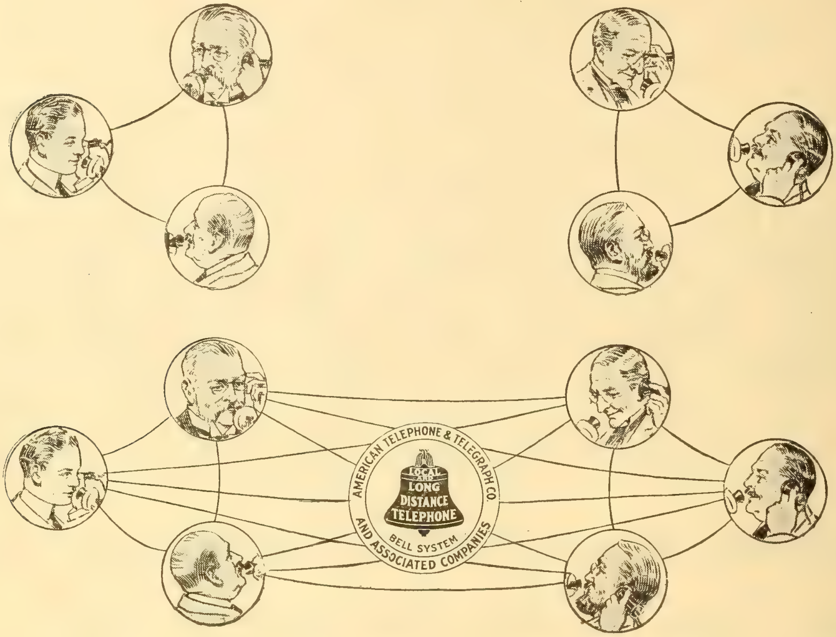
Name ....

Address ....

....

Occupation ....

Union Increases Use


AMERICAN TELEPHONE & TELEGRAPH CO.
LOCAL AND LONG DISTANCE TELEPHONE
BELL SYSTEM
AND ASSOCIATED COMPANIES

When two groups of telephone subscribers are joined together the usefulness of each telephone is increased.

Take the simplest case — two groups, each with three subscribers. As separate groups there are possible only six combinations—only six lines of communication. Unite these same two groups, and instead of only six, there will be fifteen lines of communication.

No matter how the groups are located or how they are connected by exchanges, combination increases the usefulness of each telephone, it multiplies traffic, it expands trade.

The increase is in accordance with the mathematical rule. If two groups of a thousand each are united, there will be a million more lines of communication.

No one subscriber can use all of these increased possibilities, but each subscriber uses some of them.

Many groups of telephone subscribers have been united in the Bell System to increase the usefulness of each telephone, and meet the public demand for universal service.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY AND ASSOCIATED COMPANIES

One Policy ***One System*** ***Universal Service***

CLASSIFIED ADVERTISING

¶ Advertisements in this section of Popular Electricity will cost 5 cents per word with 5% off for 3 times, 10% off for 6 times, 15% off for 9 times and 20% off for 12 times, cash with order.

¶ In order to secure the proper classification, advertisements must be in this office the first of each month preceding date of issue.

AERONAUTICS

BLERIOT MONOPLANE — GUARANTEED Flyer 25c. Antoinette Two-foot; three wheels, thrust bearing; Rubbers, Mailed K. D. 50c. Reberts, 344 Cumberland, Brooklyn, N. Y.

AVIATION DIRECTORY—QUARTERLY INdustrial Number. Information and Addresses; 7 divisions, 41 classifications; Aeroplanes, Motors, Propellors, Parts and Supplies, Manufacturer, etc. 25 cents. L. M. Allison, Lawrence, Kansas.

MODEL BALLOONS AND FLYING MAchines. How to Make Them. By J. H. Alexander. Contains complete directions for constructing models with five folding plates of working drawings, also an account of the progress of aviation. $1.50 postpaid. Popular Electricity Book Dept.

AVIATORS—NO LIMIT TO SALARY. BEST paid profession today. Home course by correspondence. Practice on standard type Aeroplane at our Aviation Field. Write for booklet entitled "Aviation," Dept. E, Chicago School of Aviation, Chicago.

"BOY AVIATORS' SERIES," SIX THRILLING airship books for young Americans. New, exciting and absorbing. Send for Vol. 1, and you will quickly want the others. Postpaid 50c. At all bookstores. Our immense catalogue free. Hurst & Co., 395 Broadway, New York.

CURTISS, WRIGHT, BLERIOT, or SANTOS-DUMONT. Blue print drawings with complete directions for building any one of the above Aeroplane Models, 25 cents postpaid. See our quarter page advertisement. International Aeroplane Co., E628 World Building, N. Y.

AGENTS WANTED

2-TICKLE-U, 3c. STIX, STOCKTON, CAL.

See what I say under "Typewriters." ATCHISON

MONEY MAKING MAIL ORDER CIRCULARS furnished free to mailers. P. E. Walter, 35 Dean St., Brooklyn, N. Y.

"PERFECTION POCKET ADDING MAchine—Lightning seller. Agents wanted. Cincinnati Specialty Mfg. Co., Dept. E, Cincinnati, Ohio.

MATCHES UNNECESSARY—BLITZ SPARKER instantly lights gas jets, ranges, etc. Sample quarter. V. Wesley, Aurora, Ills.

DON'T ACCEPT AN AGENCY UNTIL YOU get my samples and particulars. Money-makers. Address SAYMAN, 706 Sayman Bldg., St. Louis, Mo.

AGENTS—TO SELL THE "GEM" POCKET rule holder in every shop; new invention; just out; sell on sight. New Invention Co., Box 1008, Wilmerding, Pa.

AGENTS WANTED

KEROSENE MANTLE LAMPS—AMERICA'S largest variety; repeat order quality; our burner guaranteed best on the market. Guilford Co., Seville, Ohio.

BOKARA DIAMONDS—AGENTS, EVERYONE wanted to wear and sell these Famous Gems. Big profits. Sample offer and catalog, Free. Northwestern Jewelry Co., 80 Northwestern Bldg., Chicago.

SELL EAGLE BRAND MENDING TISSUES. Greatest Labor Saving Invention. 500 per cent profit. Three samples for dime. Eagle Rubber Company, 207 East Tenth St., New York.

AGENTS—IMMENSE PROFITS. VACUUM Cleaners. Everybody delighted—must have one—Sample to workers. A postal to us should mean a fortune to you. Aerio Vacuum Co., E 2000, Cincinnati, Ohio.

AGENTS—PORTABLE FOUNTAIN BATH Apparatus. Patented Aug. 1910. Gives all kinds of baths. Money maker. Partner wanted to manage plant and mail order business, G. W. Walters, Patentee, Electric Bath Co., Findlay, O.

AGENTS MAKE BIG MONEY—BIG PAY, NO experience, no capital required. 5,000 new art specialties, photo pillow tops 25c, portraits 30c, bromides 25c. New 1911 catalog and samples free. Write. Daniel H. Ritter Co., Madison St., Chicago, Ill.

AGENTS MAKE BIG MONEY SELLING OUR new gold letters for office windows, store fronts and glass signs. Any one can put them on Write today for a free sample and full particulars. Metallic Sign Letter Co., 400 N. Clark St., Chicago, Ill.

OUR ELECTRIC SPECIALTIES ARE EASY sellers and Agents' profits are big. Some choice territory still open. A penny postal will bring you full particulars. Send now. STANDARD ELECTRIC WORKS, 1200 Washington Ave., Racine, Wis.

BULLY! GREAT! IMMENSE!—THAT'S WHAT all our agents say after selling our attractive 1911 combination packages of soap and toilet articles with valuable premiums. 100 to 300 per cent profit. One Michigan agent made $65 in 47 hours; another $21 in 8 hours; another $22.50 in 10 hours; ACT NOW—NOT TOMORROW. Davis Soap Co., 27 Union Park Court, Chicago.

AGENTS—BIGGEST MONEY-MAKER known. The new Canchester Incandescent Kerosene Lamp revolutionizes old lighting methods. Burns air, not money. Six times brighter than electricity, gas or acetylene at 1-10th cost. Burns with or without mantle. Burner fits any lamp. Saves 75 per cent oil. No trimming wicks. Showing means selling. Territory going fast. Write today. Handsome outfit furnished. Canchester Light Co., Dept. P. E., 3, Chicago.

AUTOMOBILES

AUTOMOBILES—OVER FOUR HUNDRED bargains, $95.00 upward. All guaranteed! Freight prepaid! Write now for latest illustrated bulletin. MOTOR CAR EXCHANGE, Dept. A, 217 West 125th St., New York City.

BOOKS

STIX, STOCKTON, CAL.—MENDER 3c.

VENTRILOQUIST'S INTERESTING BOOKlet Free. Send stamp. Prof Baily, 771 Iglehart, St. Paul, Minn.

SWEDENBORG'S "HEAVEN AND HELL." Four hundred pages. Fifteen cents. Pastor Landenberger, Windsor Place, St. Louis, Mo.

$3.00 WORTH OF MONEY COINING BOOKS $1.00. Sent prepaid. Money back if not satisfied. Clark, P. O. Box 144, Centreville, Ala. Co., Calif.

"THREE LITTLE BOOKS FOR LADIES," postpaid in plain cover, 25c. (They tell what you want to know). O. K. Pub. Co., Clerk 191, Decatur, Ill.

READ MY NEW BOOK—ON CEMENT, Stone, iron, and wood-fibre concrete. The poor man's gold mine. Price fifty cents. Peter De Linde, Zion City, Ill.

TELEPHONE TROUBLES AND HOW TO Find Them, new 14th edition, price 25c, Hyde Pub. Co., Telephone Building, 183 Fifth St., Milwaukee, Wis.

JUST OUT—ELECTRICIAN'S MANUAL $1.50. Brook's Automobile Hand-book, 650 pages, $2.00. Catalogue for stamp. Arthur Reed, 25 Bellevue Place, Chicago.

"WIRING A HOUSE," BY H. PRATT. SHOWS a house already built; tells you just how to start about wiring it; where to begin; what wire to use; how to run it according to insurance rates, in fact, all the information necessary for wiring a house and shop. Postpaid, 25c. Popular Electricity Book Dept.

BUSINESS OPPORTUNITIES

See what I say under "Typewriters." ATCHISON.

$100 MONTHLY AND EXPENSES TO TRUSTworthy men and women to travel and distribute samples: big manufacturer. Steady work. S. Scheffer, Treas., MM 174. Chicago.

BIGGEST MONEY MAKER—ENTIRE NEW field, $10.00 day guaranteed. Abeles Co., 4220 Harrison St. Chicago.

CONDUCT A "CANDY KITCHEN." CLEAR $20 daily. Small capital required. Send for particulars. Kennon and Co.., 148 West Ontario St., Dept. C, Chicago.

START IN THE MAIL ORDER BOOK BUSIness! We can show you a proposition enabling you to make 88c profit on a dollar, yet give your customers $3.00 value. Send 10c for dollar sample and full particulars Morgan Co., 3457 N. Hamilton, Chicago.

FASCINATING. MONEY MAKING MAIL Order Business at home. Anyone Anywhere can conduct it. New plans. Everything furnished. Free Booklet tells how. Write today. W. E. Foote, Box 254, Muskegon, Mich.

BUSINESS OPPORTUNITIES

MOTION PICTURE MACHINES, FILM Views, Magic Lanterns, Slides, and similar Wonders For Sale. Catalogue Free. We also buy Magic Machines, Films, Slides, etc. Harbach & Co., 809 Filbert St., Philadelphia, Pa.

START LEGITIMATE MAIL-ORDER MERcantile business; possibilities unlimited, conducted by anyone. We print catalogs, supply merchandise at wholesale. Booklet and sample catalog free. Central Supply Co., Kansas City, Mo.

MAIL DEALERS AND ALL INTERESTED IN the Mail Order Business should send for our booklet of "Leader Advertisements." This book will be the foundation of several fortunes during 1911. Will send copy of "Leader Advertisement" and other valuable information which should save you hundreds of dollars, upon receipt of ten cents. Mail Dealers Supply House, 341 Dearborn St., Chicago.

MAKE MIRRORS AT HOME. BIG PROFITS with little outlay. One 18x36 in. mirror, costs $2.00 to $5.00. You can silver a glass this size for 20c. Send $1.00 in stamps or money order and we will send you EXPLICIT DIRECTIONS how to do it; also how to emboss, grind, foil, gold leaf, frost chip, and make imitation stained glass. How to transfer photos on glass, bore holes in glass and cut skylights. George L. Patterson & Co., Dept. 4, Brooksville, Ky.

WE START YOU IN A PERMANENT BUSIness with us and furnish everything. We have new easy-selling plans and seasonable leaders in the Mail Order line to keep our factories busy. No canvassing. Small capital. You pay us out of the business. Large profits. Spare time only required. Personal assistance. Write today for plans, positive proof and sworn statements. J. M. Pease Mfg. Co., 1185 Pease Building, Buffalo, N. Y.

A CHANCE TO MAKE MONEY—YES, elegant Free Homesteads adjoining valuable land, from which very fine bananas are now being sold, can still be had in Mexico. You need not go to Mexico, but must have five acres of bananas planted within five years. Address The Jantha Plantation Co., Block 681, Pittsburgh, Pa.; they will plant and care for your bananas on shares, so you should make a thousand dollars a year. Bananas begin bearing in about fifteen months, bringing the quickest returns of any fruit growing. The climate is delightful and the health conditions good. Should any reader desire to procure a Homestead, apply immediately.

COINS AND STAMPS

STAMPS—200 ALL DIFFERENT 10c. COINS—10 all different, 15c, large U. S. Cents, 5c. F. L. Toupal Co., Chicago Heights, Ill.

500 MIXED FOREIGN, CHILI, AFRICA, Russia, Japan, etc., 12 cents. 1,000 mixed old United States, 25 cents. Stamps bought, list 4 cents. Kleinman Stamp Co., 3643 N. Marshall St., Philadelphia, Pa.

$7.75 PAID FOR RARE DATE 1853 QUARTERS. $20.00 for a Half-Dollar. We pay a cash premium on hundreds of old coins. Keep all money dated before 1884, and send 10 cents at once for our New Illustrated Coin Value Book, 4x7. It may mean your fortune. Clarke & Co., Coin Dealers, Dept. 83, Le Roy, N. Y.

COINS AND STAMPS

ANNUAL COIN CLEARANCE SALE—THREE-dollar gold pieces, $4.25. Gold dollars, $2.20. Columbian 1892 ½-dollars, 65 cents. Early ½-dollars, Liberty head, 65 cents. Liberty head ¼-dollars, 34 cents. Isabella ¼-dollars, 55 cents; 20-cent pieces 28 cents. Ten different small war cents, 45 cents. 10 different large war cents 45 cents. All in good shape, new January 50-page selling catalogue just out, free. William Hesslein, 674 Elm St., New Haven, Conn.

ELECTRICAL MATERIAL

1,000 GUARANTEED $2 AMMETERS FOR testing batteries, 25c. postpaid. Stamps taken. Automobile Repair Company, 521-23 W. 144th St., N. Y.

RENEW DRY CELL BATTERIES; COST 1c each. Two guaranteed formulas, 10c each, or both for 15c. L. M. Kachel Co., Whitewater, Wis.

"HI-LIFE" STORAGE BATTERIES. BEST for Automobile sparking and lighting. These are high grade batteries at a remarkably low price. Guaranteed. Give us a trial or write for particulars. Discounts to the trade. NORTHWEST MFG. CO., 1247 Wells St., Chicago.

FOR SALE

500 FORMULAS, 25c. CHARLES BREUEL & Co., 117 Bloomfield St., Hoboken, N. J.

FOR SALE—MOVING PICTURE FILM, 1 cent foot. H. Davis, Watertown, Wis.

FOR SALE—PATENT NO. 968,607. Pneumatic pad for horse collars. For particulars address W. Skillman, Springfield, S. Dak.

FOR SALE—RAMBLER, 2-CYLINDER AUTOmobile, $300. Pope Toledo, 4-cylinder automobile, $600. Longest Bros., Louisville, Ky.

PATENT FOR SALE—ELECTRIC BURGLAR Alarm, Fits any door knob. Pat. No. 843,904. Chas. Mahla, 40 West 28th St., New York.

LATHES—SEND FOR FREE CIRCULAR showing bargains on small Screw Cutting Engine Lathes. S. B. Tool Co., Dept. O, South Bend, Ind.

FOR SALE—COMPLETE SET OF CASTINGS, with blue prints of 3-4 h. p. gasoline stationary engine; includes governor and timer, screws, etc. $10. Comet Motor Works, 512 W. Monroe St., Chicago, Ill.

LUBRICANTS, ASBESTOS, GRAPHITE AND mica candles for loose pulleys and shaftings; no drip; no dirt; economical. Swain Lubricator Co., 250 E. Lake St., Chicago.

MOTORCYCLES, NEW AND SECOND-HAND; motors, castings and accessories. Our Attachable Motor Outfit converts any bicycle into a motorcycle at small cost. Write for catalog and bargain list. Shaw Mfg. Co., Dept. 31, Galesburg, Kan.

FOR SALE—$1.50 WILL BUY CASTINGS AND all material for our neatly designed automatic steam engine of 1-16 h. p. Engine has fly ball governor and rotary valve with adjustment for wear. Blue prints and instruction sheets 25c. Complete engine, ready to run, $6.00. Elgin Wheel & Engine Co., Elgin, Ill.

GAMES AND AMUSEMENTS

THREE CARD TRICKS—10 CENTS. BAMBERG, 1193 Broadway, New York

GAMES AND AMUSEMENTS

FINE JUTE WIGS—SCHOOL GIRL, OLD maid, Cowboy, and Professor, 75c each. Genuine Hair Mustache, 35c. Our big catalogue free. Percy Ewing, Decatur, Ill.

PLAYS, VAUDEVILLE SKETCHES, MONOlogues, Dialogues, Speakers' Minstrel Material, Jokes, Recitations, Tableaux, Drills, Musical Pieces, Entertainments, Make Up Goods. Large Catalog Free. T. S. Denison and Company, Dept. 26, Chicago.

CABINET MAGICAL TRICKS, CONTAINS apparatus to perform 6 good tricks, 25c postpaid. Percy Ewing, Decatur, Ill.

HELP WANTED

$25 WEEKLY AND EXPENSES TO MEN AND women to collect names, distribute samples and advertise. Steady work. C. H. Emery, MF302, Chicago, Ill.

SALESMEN AND SALESLADIES—TO TAKE orders for Fans and 1912 Imported and Domestic Calendars, on profit-sharing plan. Something new. Experience unnecessary. Box 2815 T, Philadelphia.

BIG MONEY WRITING SONGS—THOUSANDS of dollars for anyone who can write successful words, or music. Past experience unnecessary. We want original song poems, with or without music. Send us your work today, or write for free particulars. H. Kirkus Dugdale Co., Dept. 13, Washington, D. C.

WANTED—A MAN OR WOMAN TO ACT AS our information reporter. All or spare time. No experience necessary. $50 to $300 per month. Nothing to sell. Send stamp for particulars. Sales Association, 611 Association Building, Indianapolis, Ind.

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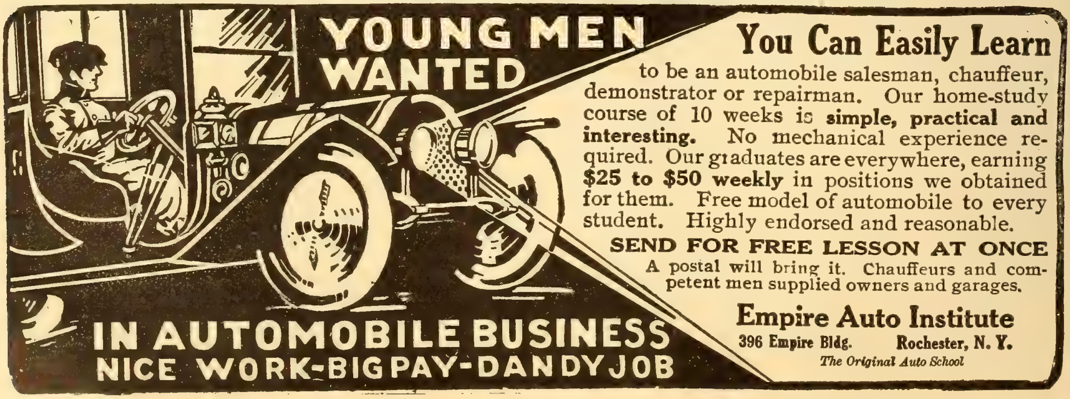

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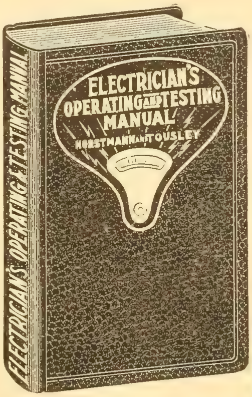
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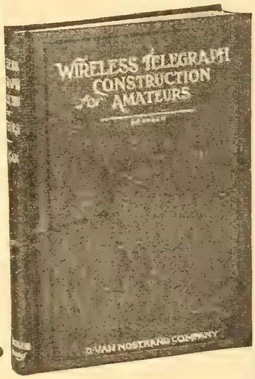

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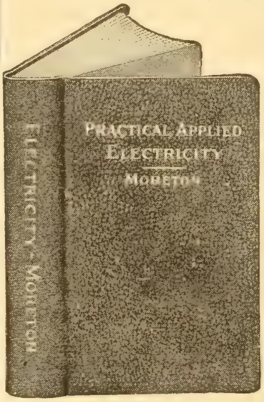

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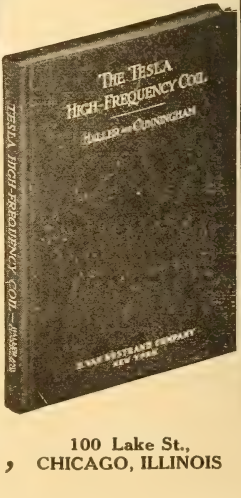
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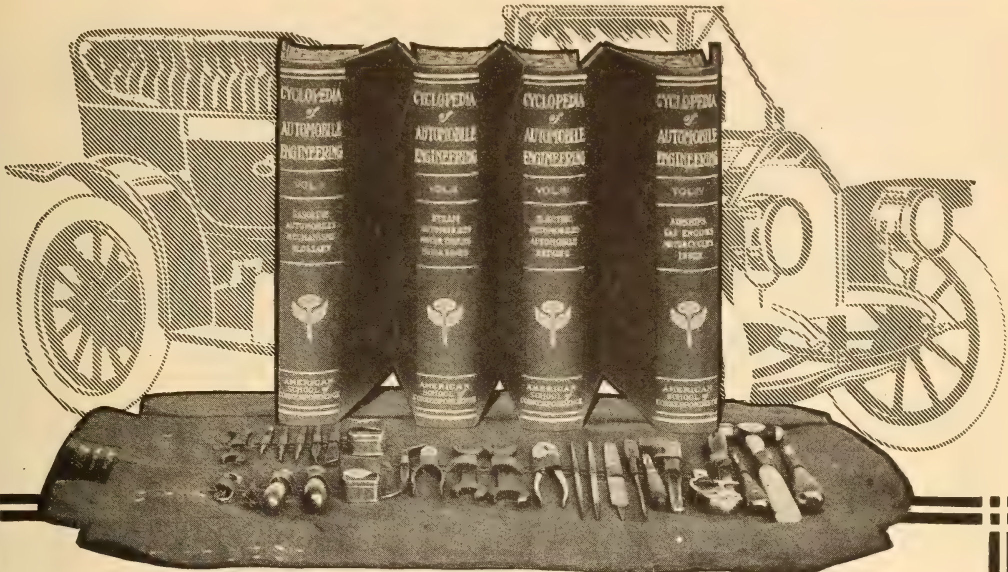
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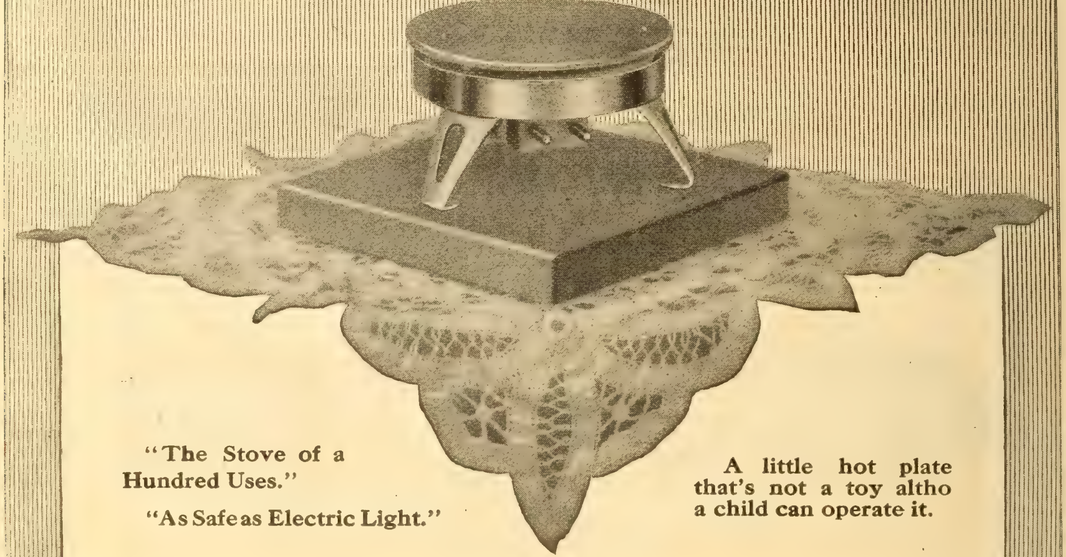

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General Electric Company

Dept. 30
Schenectady, N. Y.

LARGEST ELECTRICAL MANUFACTURER IN THE WORLD

2921

For Every Extreme of Service There Is a FORT WAYNE MOTOR THAT FITS THE NEED

a motor for the light work — a motor for the heavy work—and a motor for all the work that comes between. Direct current or alternating—constant speed or variable, for one hour duty or twenty-four, there is a Fort Wayne Motor that will save time, trouble and money for any manufacturer who uses them.

Fort Wayne Motors are standard all over the world, in the freezing atmosphere of the frigid zone or the burning tropics—in shop, factory, office or home they give continuous reliable service for a longer time than any other—with less trouble, upkeep expense, and current consumption.

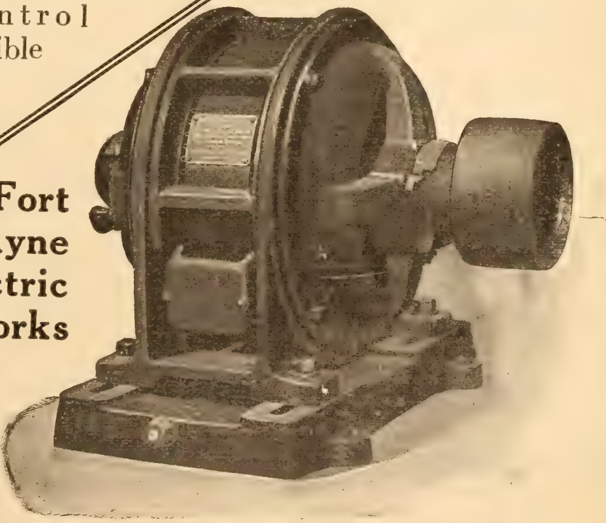
FORT WAYNE MOTORS

furnish freedom from transmission trouble and accidents and furnish you with increased production at less expense and trouble. Fort Wayne Motors furnish perfect control of your power—when you wish to use a machine you pull a lever and get just the speed you need—the maximum speed that tools and material will stand—you get control that would be impossible with shafting, belts and pulleys When you are finished you can shut off the power.

make the installation of a new machine or the entire new equipment of your factory interior possible and as easy to do as to put another desk in your office. Why not investigate and see if these claims can be substantiated? If there is a way to produce your product easier and more economical you want to know it. Find out now. Send for our bulletin "Motor Drives." Tell us of your present equipment and let us help you to find out if you are getting your work done as cheaply as you can.

m24

Branch Offices in Most Large Cities



Fort Wayne Electric Works

"Wood" Systems

1603 BROADWAY
FORT WAYNE, INDIANA

Conclusive proof of the superiority of

The Edison Storage Battery

is shown in the fact that these well-known firms have replaced lead batteries with Edison—and have re-purchased Edison Batteries when increasing their equipment.

The Adams Express Company, seven years ago replaced lead batteries in four of their vehicles with Edison equipment. Since that time they have purchased over 150 cars, all Edison equipped.

Tiffany & Company replaced lead batteries with Edison batteries in three of their wagons seven years ago. They have since bought 18 more cars, all Edison equipped.

Hearn & Son after operating 15 Edison equipped cars for three years, discarded lead battery equipment in 12 more cars and installed Edison batteries.

Frederick Loeser & Company, after operating an Edison battery for one year in one of their vehicles, replaced lead batteries with Edison batteries in 6 more cars.

The United States Express Company have been operating 25 vehicles with Edison batteries for several years.

Abraham & Strauss, when they decided to put in motor vehicle equipment, purchased 12 cars equipped with Edison batteries.

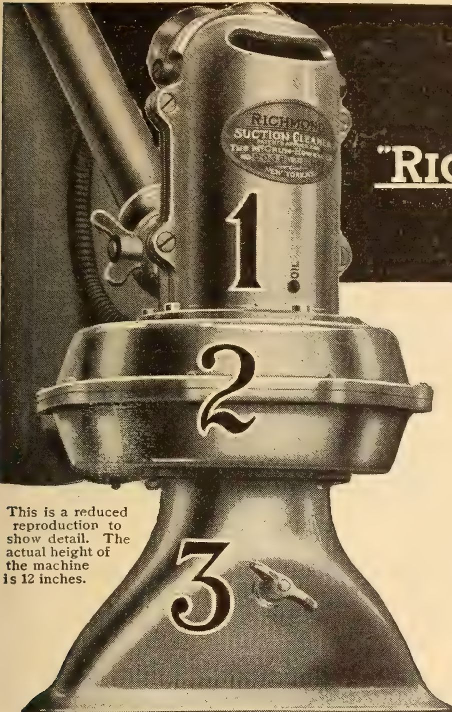
Aitken Son & Company, and A. A. Vantine & Son have been operating 13 Edison equipped vehicles over a period of four-and-a-half years.

R. H. Macy & Company, have been operating 17 Edison battery equipped cars for the past three and a half years.

Besides, four of the foremost makes of electric pleasure vehicles are now regularly equipped with the Edison storage battery—Detroit, Bailey, Baker & Waverley—and these vehicles are today giving more than double the mileage of electric pleasure vehicles with lead batteries—an average well over a hundred miles on a charge, while the lead battery in most instances will not give an average better than 50 miles on a charge.

Write us today

Edison Storage Battery Co., 117 Lakeside Ave., **Orange, N. J.**



This is a reduced reproduction to show detail. The actual height of the machine is 12 inches.

One Dollar
Puts the "RICHMOND" Suction Cleaner in Your Home

ONE Dollar forever frees you from brooms, mops and dusters—and the backaches and drudgery they bring.

One Dollar forever stops the expense and the nuisance of Spring and Fall housecleaning.

One Dollar enables you to do, *easily*, by electricity, the *worst work* a woman has to do.

And One Dollar is the only cash outlay.

It will bring you the "RICHMOND" Suction Cleaner complete—ready for instant use.

The balance you pay for month by month out *of the actual money you save.*

For Vacuum Cleaning is the greatest of all household economies.

You are paying the price of a suction cleaner, *right now*—whether you have one or not.

You are paying its price out in twice-a-year house cleaning alone—for a "RICHMOND" makes housecleaning needless.

You are paying its price out—many times over—in the hard labor of sweeping and dusting which the "RICHMOND" makes unnecessary.

You are paying its price out again and again in the damage which dust does to your furniture, to your carpets, to your hangings, to your clothing—to YOU.

You are paying the price of a "RICHMOND" when a single dollar would save the waste.

YOU see here the lightest and simplest suction cleaner *ever designed.*

1.—is the motor—not a "stock" motor, but one built expressly to operate the powerful suction fan to which it is directly connected, under

2.—a suction fan which embodies the best of all that was learned in two years of steady, scientific experiment.

3.—is the suction nozzle which is pushed over the surfaces to be cleaned—or to which can be attached a twelve-foot hose for high wall, drapery and upholstery cleaning.

The "RICHMOND" Suction Cleaner enables you, now for the first time, to clean by electricity without lugging a 60 to 80 pound machine from room to room—upstairs and down.

It represents as great an advance over heavy weight vacuum cleaners as these cleaners represented over brooms and carpet sweepers.

But light weight and easy operation are but two of the "RICHMOND'S" exclusive superiorities. There are many more.

The vibrating brush, which taps the caked dirt out of otherwise uncleanable rugs and carpets—the hair-drying and pillow-renovating attachments—the seven special tools which make the "RICHMOND" the most complete cleaner ever offered.

Manufactured exclusively for the RICHMOND SALES CO. by

THE McCRUM-HOWELL CO.

103 Park Ave. and 41st St., New York

Five Factories: Two at Uniontown, Pa.--One at Norwich, Conn.
One at Racine, Wis.---One at Chicago, Ill.

MANUFACTURERS OF "RICHMOND" Boilers and Radiators, "RICHMOND" Enameled Ware, Bath Tubs, Sinks, Lavatories, "RICHMOND" Suds Makers, "RICHMOND" Concealed Transom Lifts, and "RICHMOND" Stationary Vacuum Cleaning Systems

Inquiries regarding built-in-the-house Vacuum Cleaning systems should be addressed to The McCrum-Howell Co., New York and Chicago.

Limited Offer

The Dollar Offer is limited. It is made to show our unbounded confidence in the "RICHMOND"

But by its very liberality, it is bound to swamp the factory. And when the limit of factory output is reached, the offer must be withdrawn.

So send the coupon today while the opportunity is still yours! Don't wait. Do it NOW.

THE RICHMOND SALES CO.
Dept. 73, 103 Park Ave. New York

DOLLAR COUPON

THE RICHMOND SALES CO., Dept. 73, 103 Park Ave., N. Y City

I hereby order one "RICHMOND" Suction Cleaner, complete with the following attachments:

1 Hose Attachment Shoe
1 12-ft. covered Suction Hose
1 Book and Wall Brush
1 10-in. Drapery Tool
1 3-in. Suction Tool
1 Felt-Faced Floor Tool
1 Adjustable Wall Brush
1 30-ft. Electrical Cord
1 Complete Hair Drying Attachment

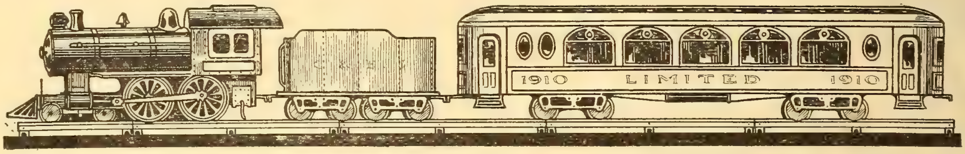
—for which I agree to pay to your order, $1.00 herewith, and $6.00 on the first day of each of the next 12 consecutive months. Title to be given me when full amount is paid.

Name..

Address..

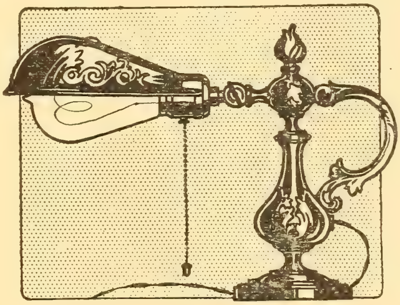
A Few of the Many Modern Electrical Appliances Demonstrated and Sold at Electric Shop

Electric Shop is the home of everything electrical for comfort, convenience, the reduction of labor and the beautification of the home. From among the more than two thousand things electrical sold here, we call particular attention to the appliances described below.



Everything in Electrical Toys

We carry a complete line of Electrical Toys, including Railroad Engines, Cars, Trackage, Tunnels, Bridges, Stations, Signals, etc., Gunboats, Submarines, Launches, Saws, Drills, Punches, etc., etc. Prices on request.

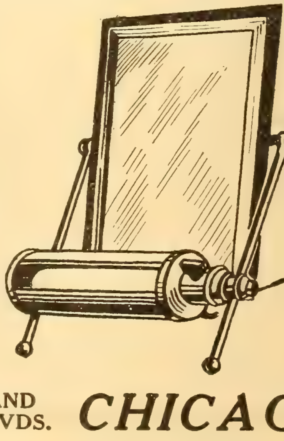


Electric Couch Bracket

This ingenious little electric lamp has several uses. It may be hung upon the back of a bed to afford light to the reclining reader. Or it may be used on the piano to light the music, or may be used on the desk or reading table. Handsomely finished in antique brass, with cord and plug attached. Order No. 404. Price, express prepaid, **$4.25.**

Electric Shaving Mirror

This mirror is equipped with a lamp which throws a brilliant light on the face, below the eyes. Mirror and lamp can be adjusted to any angle. The most practical and convenient shaving mirror made. Price, express prepaid, **$4.25.**



Other Electrical Appliances

Chafing Dishes, Candlesticks, Flat Irons, Curling Irons, Soldering Irons, Glue Pots, Radiators, Portable Lamps, Dining Table Domes, Massage Vibrators, Vacuum Cleaners, Washing Machines, Christmas Tree Lights, Illuminated Floral and Fruit Table Decorations, etc. Prices on request.

When visiting in Chicago, make it a point to visit this home of everything electrical.

ELECTRIC SHOP MICHIGAN AND JACKSON BLVDS. **CHICAGO**

The Beginning of His Success

Success has dawned for many a man with the marking of the I. C. S. coupon. It was a simple act—an act that placed him under no obligation—but it proved to be the beginning of a career.

Trained men are in demand everywhere. There is not an important labor-employing concern in the world that has not openings for men prepared to make good in positions.

Draftsmen are wanted. Can you trace out a machine or a building? Foremen and Superintendents are wanted. Can you plan and direct work? Chemists are wanted. Can you make an analysis or build up a useful compound? Trained Electricians are wanted. Would it be safe to turn you loose in an electric plant? Civil, Mechanical, and Mining Engineers are wanted. What does that mean to you? Advertising men are wanted. Can you write a business-pulling ad? The Civil Service needs men. Are you prepared to pass a Civil Service examination?

No matter where you live, how little spare time you have, how limited your education (provided you can read and write), nor how small your means, the I. C. S. will go to you and train you in your own home for mastery of the trade or profession you like.

The marking and mailing of an I. C. S. coupon has been the beginning of success for thousands. Why not find out about the I. C. S. plan? It will place you under no obligation whatever but will bring to you a full explanation of the I. C. S. salary-raising system that has been used by thousands to change poor jobs into good positions and "wages" into salaries.

Mark and Mail the Coupon NOW.

International Correspondence Schools
Box 1102, Scranton, Pa.

Please explain, without further obligation on my part, how I can qualify for a larger salary and advancement to the position, trade, or profession before which I have marked **X**.

Electrical Engineering
Electric Lighting
Electric Railways
Electrician
Electric Car Running
Dynamo Foreman
Dynamo Tender
Wireman
Mining Engineer
Telephone Expert
Civil Engineer
Automobile Running

Mechanical Engineer
Mechanical Draftsman
R. R. Constructing
Concrete Construction
Architect
Contracting & Building
Architectural Draftsman
Plumbing & Heating
Chemist
Bookkeeper
Advertising Man
Civil Service Exams.

Name ______________________

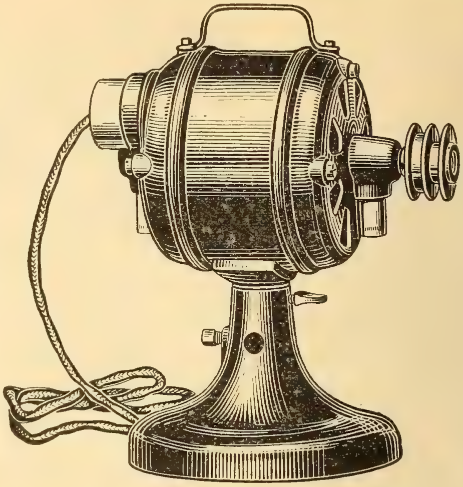
St. & No. ______________________

City ______________ *State* __________

Present Occupation ______________________

Westinghouse General Utility Motor

$18.25



Bases and Attachments Extra

To the Man With the Little Shop Either For Work or For Fun

THE Westinghouse General Utility Motor has just enough power to do the work you want it to do without waste of either power or money.

Through the aid of different attachments it will do a dozen different things. Run a lathe. Grind tools or knives. Run any light machinery. Polish anything polishable. Run a direct connected blower.

Given the motor and a list of attachments, any shop man can think of many uses for the motor.

It is invaluable in the house to help a woman with her housework. Does anything from running the sewing machine to polishing the silver.

Send today for the little booklet that tells all about it. Direct your letter to "Westinghouse Dept. of Publicity, Pittsburg."

Westinghouse Electric & Manufacturing Company
PITTSBURG

Sales Offices in 40 American Cities **Representatives All Over the World**

CYCLOPEDIA of APPLIED ELECTRICITY
ELEMENTS OF ELECTRICITY WIRING TELEGRAPHY
VOL. I
DYNAMO ELECTRIC MACHINERY
VOL. II
ELECTRICAL MEASUREMENTS LIGHTING RAILWAYS
VOL. III
AMERICAN SCHOOL CORRESPONDENCE

Here is the Standard Reference Work on Electricity

and we want you to examine it absolutely free of charge in your own home or office. Read our Liberal Selling Plan—it tells how we will send you the great six-volume

Cyclopedia of
Applied Electricity

upon receipt of the coupon and allow you to examine it free of charge.

We have confidence in this great cyclopedia; we know that it is **the reliable authority** on electricity. It is compiled from the instruction papers of the American School of Correspondence, written by thirty of the world's greatest electrical experts. We want you to endorse our claims and for this reason we make you this free offer.

If you want to be an expert—an authority on everything electrical, you need a work that covers every phase of electrical engineering—a work that will tell you what you want to know in plain English without technical terms and formulas. That is just what you have in this cyclopedia. These books cover every branch of electricity thoroughly, exhaustively, from the elements of electricity to the design and construction of power and central stations. Read "Important Subjects Covered," and then mail the coupon. The six volumes contain 2,896 pages, 7x10 inches in size; 2,000 special illustrations, photographs, plates, diagrams, tables, etc., beautifully bound in half morocco; titles stamped in 23-karat gold.

This Is Our Liberal Selling Plan

Upon receipt of the coupon the books will be sent you, express prepaid, for 5 days' free examination. If you decide to keep the books, send us your initial payment of $2.00 within five days and $2.00 every month until you have paid the special price of $18.80. The regular price is $36.00. If, after thoroughly examining the books, you do not see your way clear to keep them, notify us and we will send for them at our expense. Send the coupon today.

IMPORTANT SUBJECTS COVERED

Types of Dynamos and Motors; Elevators; Direct-Current Motors; Electrical Measurements; Electric Lighting; Electric Railways; Alternating Current Motors, etc.; Electric Welding; Mercury-Vapor Converter; Management of Dynamos and Motors; Power Stations; Central-Station Engineering; Central-Station Design; Storage Batteries; Power Transmission; Electric Wiring; Electric Telegraph; Wireless Telegraphy; Telephony; Automatic Telephone; Wireless Telephony, etc.

For a short time we will include as a monthly supplement, for one year, the TECHNICAL WORLD MAGAZINE. This is a regular $1.50 monthly, full of Twentieth Century scientific facts, written in popular form. Also contains the latest discussion on timely topics in invention, discovery, industry, etc.

AMERICAN SCHOOL OF CORRESPONDENCE
CHICAGO, U. S. A.

P. E. 3-11

A. S. of C.

Please send set Cyclopedia of Applied Electricity for 5 days' free examination, also Technical World for one year. I will send $2.00 within 5 days and $2 00 a month until I have paid $18.80, or notify you and hold the books subject to your order. Title not to pass until fully paid.

NAME ....

ADDRESS ....

OCCUPATION ....

REFERENCES ....

THE WORLD'S LATEST INVENTION

DARCHE UTILITY HOUSEHOLD ELECTRIC CLOCK AND MEDICAL BATTERY

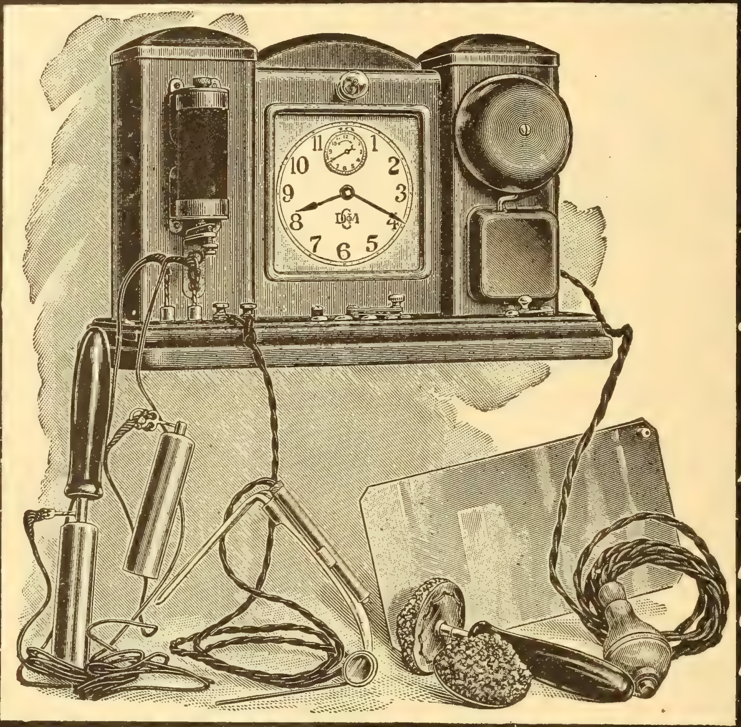
(PATENTED)

Absolutely necessary in every household

To see the time

Electric Alarm Clock

Electric Night Light by pressing the button



Electric Call Bell

Electric Bell Alarm

Electric Lamp to examine the throat teeth and mouth

Electric Medical Battery and all attachments

ALL IN ONE

READY FOR USE. OPERATED BY DRY BATTERIES

Send for illustrated booklet showing uses with full directions. General Agents wanted everywhere. Address all communications to

DARCHE MFG. CO.

(ESTABLISHED 1882)

2117 S. HALSTED ST.

CHICAGO

BRANCH
NEW YORK

FACTORY
DETROIT

Have The Readers of "Pop" The Courage To Buy A Motor That Is

UNORTHODOX AND BETTER

I am putting this advertisement in Popular Electricity alone, in order to test the pulling power of this splendid little paper and the *buying* power of its readers.

I am willing, of course, to send circulars to students or other young men who are as yet learners rather than buyers, because the learners of today are the buyers of tomorrow.

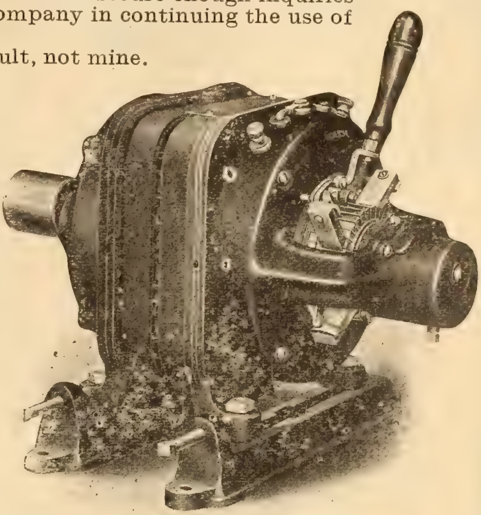
But the purpose of *this particular* advertisement is to secure enough inquiries from *actual users* of Electricity to warrant my company in continuing the use of this medium.

If the ad. is not repeated, it will be your fault, not mine.

THE KIMBLE MOTOR IS UNLIKE ANY OTHER MOTOR—AND BETTER

I have faith to believe that it will supplant all other forms of A. C. motors, in your lifetime and mine, because it is such a distinctive *advance* in motor design and construction, doing so many things that no other A. C. motor will do—and at *so much less cost* for power.

But; it is hard to teach old dogs new tricks, and it's the old dogs who do the buying. So I put it up to you who read this page to investigate the Kimble Motor on your own account with minds free from all preconceived notions.



Here are some of the "impossible" things the Kimble Variable Speed, Single Phase, Alternating Current Motor does:

1. Operates on Single, Two or Three-Phase circuits interchangeably.
2. Gives varying speeds (not steps merely, but every shade from 300 to 3,000 r. p. m.) without resistance coils or *any* other outside controlling device.
3. Starts, stops, reverses and changes speed (from full speed forward to full speed backward) by means of *one single lever* that is on the motor itself.
4. Starts with full load torque, and uses no more current in starting than is used at full load running current.
   In other words, a given speed consumes a given current; *half* the speed *half* the current, with none of the electricity wasted in resistance coils or other makeshifts.
5. Is the most silent, the most economical and the most nearly "fool proof" motor now on the market.
6. It makes alternating current electricity the cheapest, most efficient, most easily worked with form of electricity, superior in every way to the more popular direct current.

Have I told you too much?
Or, do you want to know still more?
Will you believe your own eyes when you see the motor *doing* all these things, and many more?
No matter: you won't have to take anything on faith: my Company embodies all its 13 claims in a *guarantee contract*, by which we agree to perform the 13 "impossible" things and keep on doing it for TWO YEARS.

Kimble Reversible Single Phase A. C. Motors are supplied in ⅛ to 1½ H. P.; 110 and 220 volts, 60 cycles. Also ⅛ H. P., Non-Reversible.

FILL OUT THE COUPON NOW

Jas. K. Bass, Gen'l Mgr.

Kimble Electric Company
1119 Washington Blvd.,
CHICAGO

[All the coupons that come in from Popular Electricity will be properly recorded. All letters and requests for information will be answered and literature sent. A careful record of sales that result will be made, and on this test Popular Electricity will win or lose our season's advertising contract.]

COUPON

MR. JAMES K. BASS, Gen'l Mgr.,
Kimble Electric Company, 1119 Washington Blvd., Chicago

Dear Sir:—Please send your literature on Kimble Motors. Am particularly interested in knowing the advantage of Kimble Motors for use in

....

....

SIZES PROBABLY REQUIRED.................................*H. P.*

NAME..

FIRM..

TOWN............................ *STATE*.................

STREET ADDRESS..

3 YEARS TO PAY FOR THE SPLENDID

Meister Piano

PRICE
Guaranted for 10 Years **$175**

30 Days Free Trial

IN YOUR OWN HOME

No Cash Payments Down. No Interest. No Extras.

We Pay the Freight

Handsome Stool and Scarf Free

$1 A WEEK. $5 A MONTH.

Just to prove to you the splendid worth of this MEISTER piano, let us send it to you on thirty days' free trial. It wont cost you a penny or a moment of bother. **First,** send for our beautifully illustrated MEISTER catalog and see how the Meister is made and the materials used in its construction. Read therein the testimony of delighted owners. Select the style you like and send in your order. We'll do the rest. The piano will be shipped to you promptly, freight prepaid, no matter where you live. Try it a month at our expense. You will be under no obligation **until you decide to buy.** Then you may take full advantage of our easy payment plan which makes it easy for any man of modest income to own this famous instrument. If you dont find it to be precisely as we have represented—if you don't regard it as the richest toned instrument you have ever heard then we'll take it back after the month's free trial and it hasn't cost you a cent.

SOLD DIRECT FROM FACTORY TO YOU.—We deal only with the people direct and sell more pianos than any other firm in the world. We are sole makers of the MEISTER piano. It is produced in our own magnificently equipped factories and sold direct from the factory to you **minus** the usual profits of jobber, retailer and special salesman. There is only one small profit and that is ours. We were obliged to secure extra factory facilities this year because of an enormously increased demand and we are doing the finest work in the history of piano making. This instrument is made of the very finest materials by men who have earned their way because of efficiency, and is fully guaranteed for 10 years. **WE WILL SEND THIS PIANO TO ANY HOME IN AMERICA ON THIRTY DAYS FREE TRIAL,** or any one of the other four styles, some of which are very elaborate and beautiful. If you have a son or daughter to educate nothing will prove so acceptable to them as as one of these handsome richly-toned pianos. At any rate send for it and let the children try it. Let the question of buying pass until then. Send for the catalog today. A post card will bring it.

Rothschild & Company's resources are in excess of $3,000,000.00.

THE MEISTER PIANO CO.

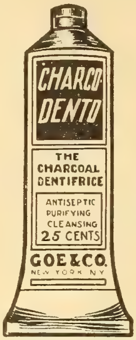
Rothschild & Company, Sole Owners

State, Van Buren and Wabash Ave. Dept. 20 C, Chicago, Ill.

CLEAN, PRESERVE *and* BEAUTIFY

your TEETH by using

CHARCO-DENTO



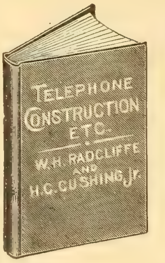
The Charcoal Dentifrice

Charcoal is nature's greatest purifier. It absorbs and carries away acids and decayed food which destroy teeth. Charcoal, combined with other beneficial ingredients in **CHARCO-DENTO**, keeps teeth and gums in perfect condition.

25c a tube at druggists or sent by mail on receipt of price.

GOE & CO., 1 Golane Building, RIDGEWOOD, N.J.

TELEPHONE CONSTRUCTION
INSTALLATION WIRING, OPERATION AND MAINTENANCE



By Radcliffe & Cushing

A practical reference book and guide for amateurs, electricians, wiremen and contractors, showing the principles of construction and operation of telephone instruments and improved methods of installing and wiring them.

Line wiring and the wiring of special telephone systems is also covered.

100 Pages 125 Illustrations

PRICE $1.00—POSTPAID

POPULAR ELECTRICITY BOOK DEPT.

TOWER'S PATENT ROUND END

ANTISEPTIC TOOTHPICKS

Aromatic *Highly Flavored*

Physicians and dentists recommend toothpicks as protection against dental decay. Our patent aromatic antiseptic picks are the best made. They preserve the teeth, sweeten the breath and increase the flow of saliva. Flavors are cinnamon, sassafras and peppermint. Full size box sent for 15c. postage and coupon below. We are the largest manufacturers of toothpicks in the country.

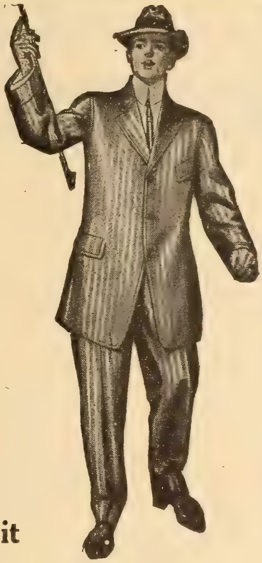
CUTTER TOWER CO., 184 Summer Street **Boston, Mass.**

Correspondence invited with **dealers, hotel men, dentists and physicians.**

We want dealers and agents everywhere. **Agents are making from $3 to $10 a day.**

CUTTER TOWER CO., 184 Summer St., Boston, Mass.
Enclosed find 15c. for which please send me one box of
300 Aromatic Antiseptic Toothpicks..................*flavor.*
My grocer's name is..................
My druggist's name is..................
Yours truly (Name)..................
(Address)

All-Wool Clothes On Credit



Suits in All-Wool Fabrics
Made to Fit
$12.95
to
$35.00

Smartest Styles

Sent on Approval
Sold on Credit

Samples Free

We are making clothes for tens of thousands of dressy young men. We save them from 30 to 50 per cent because we deal direct, and they take their own measurements. No local agents to pay.

We use nothing but all-wool fabrics, acid-tested, London shrunk. Clement clothes always hold their shape, and they never fade.

Clothes are sent on approval. If not satisfactory in fit, materials or tailoring you can send them back, and we will pay express both ways.

If you are perfectly satisfied you can pay a little each month for six months. No extra price, no interest, no security, no red tape. We simply open a charge account as we have with thousands of others.

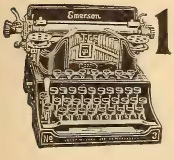
The Clement Style Book for spring is ready, showing all the clever designs in young men's clothes.

With it we send big book of samples of all-wool fabrics in the newest patterns. Also a tailor's tape for taking measurements. The suit prices range from **$12.95** to **$35.00.**

Send us your name and address—a postal card will do—and this whole new outfit will be mailed you free. Write us now. We will save you from **$10** to **$20** on a suit for spring and you can have six months to pay. (16)

THE CLEMENT CO.

3544 Morgan St. Chicago



10 CENTS A DAY

buys the Emerson Typewriter.

Made in our own factory at Woodstock, Ill. $50 **now—later the price will be $100.** The best typewriter made. Entire line visible. Back spacer, tabulator, two-color ribbon, universal keyboard, etc Agents wanted everywhere. **One Emerson machine free** for a very small service. No selling necessary

To Get One Free and to learn of our easy terms and full particulars regarding this unprecedented offer, say to us in a letter, "Mail your FREE OFFER."

The Emerson Typewriter Co., Box 69, Woodstock, Illinois

TAKE IT OFF

AD-EL-ITE

TRADE MARK REGISTERED

PAINT & VARNISH REMOVER

PAINT AD-EL-ITE SPECIALTIES

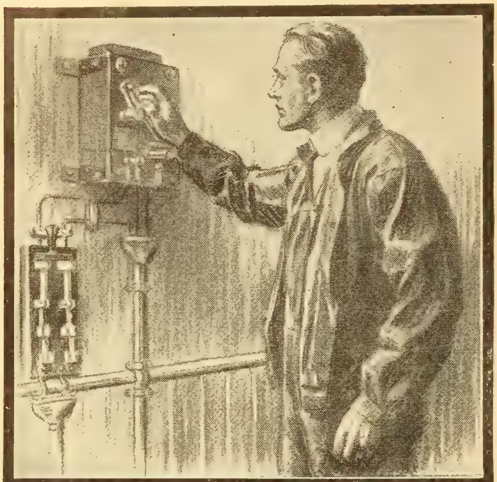
Take off that old coat of shabby paint, varnish, wax, shellac or enamel and make your furniture and woodwork look like new. You could not believe without a trial what quick, clean work it does. Ad-el-ite Paint and Varnish Remover is harmless to the hands, finest woods or fabrics, and leaves the surface in perfect condition for refinishing with our

ONE-COAT MISSION FINISH

A stain and finish in one application, giving that popular velvety Mission effect to either hard or soft wood. Brings out and preserves the grain beauty and goes about twice as far as ordinary goods. Makes your old furniture new and attractive at trifling cost. Sample panels free. Ask your dealer or write us.

Dept. 83 CHICAGO

ADAMS & ELTING CO.



Become An Expert Electrician In Spare Time

Never has there been such a demand for technically trained electrical men as at present. The great expansion of the electrical field in all its branches is responsible for this. The trained electrical man is always sure of a good position at a good salary.

The International Correspondence Schools have made the mastery of any electrical course easy. Any ambitious man can learn *in spare time* to become an expert electrician. *You* can.

Courses cover Electrical Engineering, Lighting and Railways, Interior Wiring, Dynamo Running, Electric Car Running, Heavy Electric Traction, Telephone Engineering and Telegraph Engineering. Everything made clear and simple. Courses conducted by experts. No hurry or delay. The I. C. S. stands by you until you are through.

It costs you nothing and puts you under no obligation to learn *how* the I. C. S. can help you. Simply fill in and mail the attached coupon to-day. Do it *now*.

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International Correspondence Schools
Box 1102, Scranton, Pa.

Please explain, without further obligation on my part, how I can qualify for a good position in the line of electrical work indicated in the attached coupon:

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Bargain Book Edition No. 24

Picturing 3,000 Furnishings
Bought When Makers
Needed Money

Cash or Credit

Our whole business is to buy and sell bargains in house-furnishings. We buy surplus stocks on which makers dare not cut prices to dealers.

Hard-up makers unload on us, and we sell direct to the user at savings up to 50 per cent.

Our latest Bargain Book pictures 3,000 articles at almost unbelievable prices.

Furniture
Carpets
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Baby Cabs, etc.

Most of these things were bought in midwinter, when makers had to sell.

Pay as Convenient

We sell for cash or credit at an equal price. We have charge accounts with 600,000 homes. They take, on the average, a year to pay—a little each month.

You are welcome to such an account if you wish it. There is no interest, no security, no red tape or publicity—Just an open charge account. We gladly trust people who [illegible] things for the home.

Everything is sent on 30 days' approval. Use it a month before deciding to keep it. If it isn't such a bargain as you expect, return it at our expense for freight both ways.

On these fair lines we have built up here the largest trade in our line in the world.

Bargain Book Free

This mammoth book of 3,000 bargains—size 12x24 inches—will be mailed you free. It pictures more articles and quotes lower prices than any book of its kind ever issued. Every home should have it.

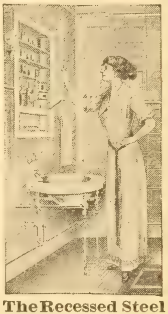
Simply send us your name and address—a postal will do. Write it now, before you forget it, and the book will be mailed you free.

Spiegel, May, Stern Co.

1384 35th Street **CHICAGO**

HESS MEDICINE SANITARY CABINET LOCKER

The Only Modern, Sanitary STEEL Medicine Cabinet



The Recessed Steel Medicine Cabinet

or locker finished in snow-white, baked everlasting enamel, inside and out. Beautiful beveled mirror door. Nickel plate brass trimmings. Steel or glass shelves.

Costs Less Than Wood

Never warps, shrinks, nor swells. Dust and vermin proof, easily cleaned.

Should Be In Every Bath Room

Four styles—four sizes. To recess in wall or to hang outside. Send for illustrated circular.

HESS, 912 L Tacoma Bldg., Chicago
Makers of Steel Furnaces. *Free Booklet.*

DIAMONDS ON CREDIT WATCHES

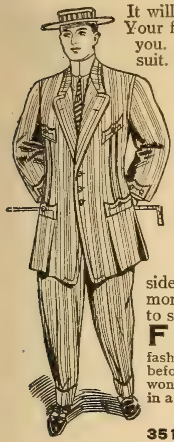
BIG BARGAINS ***WRITE FOR CATALOG***

Write for our handsome 100-page Catalog. Over 2,000 illustrations of Diamonds, Watches, Artistic Jewelry, Silverware, Novelties. Every article priced 10 to 20 per cent lower than others charge for equal value. Let us send you a fine Diamond or Watch on approval, all charges prepaid. If satisfactory, keep it and send us one-fifth of the price, balance in eight equal monthly amounts. Great bargains in ladies' and men's Watches. Our new booklet, **"Historic Diamonds,"** sent free on request.

LOFTIS BROS & CO. EST'D 1858 **THE OLD RELIABLE ORIGINAL DIAMOND AND WATCH CREDIT HOUSE**

Dept. C685, 92 to 98 State St., Chicago, Ill.—*Branches: Pittsburg, Pa. and St. Louis, Mo.* | **Write for Catalog today.**

Want Spring Suit?



It will cost you nothing. Everybody needs clothes. Your friend, neighbor or acquaintance will buy of you. Profit on two orders will get you a free suit. The easiest thing in the world.

BIG OUTFIT FREE

We give you a bigger and better line and make our prices lower than any other house in existence. Our system insures a better fit, better work and better service. No express charges.

CLOTHING AGENTS

WANTED—Now is the time to get in the game. Our men make from $5 to $15 a day easy. Take up the clothing business as a side line—it will pay you well. You need no money or experience. We furnish everything to start.

Free Complete Sample Outfit including big assortment of cloth samples, latest fashions, tape measure, special offer. Write at once before we get someone else in your town. This is a wonderful opportunity to make money and start you in a well paying business.

THE CAPITOL TAILORS
351 Capitol Bldg. **CHICAGO**

WHEN desirous of information inquire at the information Dept. of Popular Electricity Pub. Co.

PUNCTURES REPAIRED BICYCLE TIRES FREE

CLOVERLEAF BRAND FIXITFREE TIRES, are nearly perfection or we could not afford this guarantee; 99 per cent of the value in a tire cannot be seen, you cannot judge a tire by the looks; all look alike except the tread design, which has no value nor merit; only fancy. Wearing and puncture resisting qualities are what count. This is the service you are willing to pay for; TROUBLE SAVING, this is what we offer you. On usual guaranty you receive nothing in this direction, but unkept promises and "Hot Air"

Our Guaranty covers the unseen, the unknown parts; guarantees you the year's tire service WITHOUT EXTRA COST to you. All punctures and other repairs MADE FREE, or replaced with new tires, without charge, regardless of what or who is at fault. No questions, we simply do it. Local Dealers handling this brand of tires can do the same. INSURANCE TAG ATTACHED TO EACH TIRE This special introductory price now. Order early; give size wanted; Catalog Free.

Agents Wanted. **THE VIM** Chicago, Ill. Des Moines, Iowa Minneapolis, Minn.

CLOVERLEAF BRAND *WE PAY EXPRESS*

$5.85 PER PAIR FIXIT FREE

A MAGAZINE OF THE POCKET-BOOK

Everyone now interested in real estate, or about to become interested in it, should send at once for a free copy (or 25 cents postage for yearly subscription), for the best magazine in that field.

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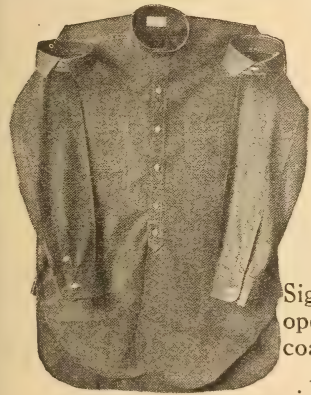
AGENTS Portraits 35c, Frames 15c, Sheet Pictures 1c, Stereoscopes 25c, Views 1c. 30 Days' Credit. Samples and Catalog Free.
CONSOLIDATED PORTRAIT, Dept. 1408, 1027 W. Adams St., Chicago



If Your Dealer Doesn't Carry Signal Coat Shirts Send for a Couple at Our Risk

We want you to know the comfort, wear and good looks of Signal Coat Shirts—we want you to realize the advantage of the open front which enables you to slip the shirt on or off like a coat. No tugging over the head.

Ask your dealer to show you this shirt. Note the many points and advantages to be had on no other shirt. *Extra button at bottom of breast plait*, to keep the front smooth, sleeve slit in the side not in seam and reinforced with rip proof band. Two double band collars, *hand turned*, two pockets. Made from fast indigo percales. Seams double sewed.

If not obtainable in your town, send size and we will express you a couple, charges prepaid. If satisfactory, pay expressman $1.00 each. (West of Missouri River $1.25.) If not what you want, return at our expense. Write for folder showing extra styles in neat colored designs for semi-dress at $1.50, collars to match.

Hilker-Wiechers Mfg. Company
1248 Mound Avenue **Racine, Wisconsin**
Makers of Signal Overalls

SIGNAL SHIRT
Union Made

CUTLER-HAMMER

Electric Heating Devices

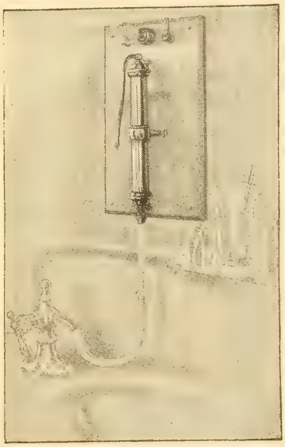
The many uses for which the Cutler-Hammer Electric Disc Stove is adapted makes it a necessity in every household. It has a seven inch heating surface and is artistically designed, and finished in polished nickel plate.

Portable Water Heaters are for use in home, restaurant, drug store, bar, etc. They furnish hot water in less than a minute after current is turned on.

The Therapeutic Heater provides steaming hot water in a few seconds. In the dentist's and physician's office they are invaluable for sterilizing instruments and for many other purposes.

Send for our 32-page Booklet.

Electric Disc Stove
Useful for many purposes



Instantaneous Water Heater
Therapeutic Style—Four other styles

Electric Water Heater
Three Quart Size
Four Quart Size also Made

The Cuttler-Hammer Mfg. Co.
MILWAUKEE, WISCONSIN

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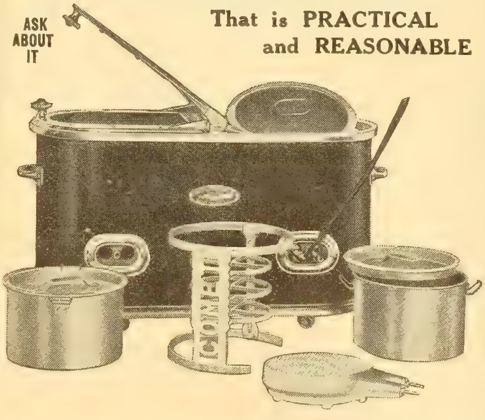
COMET ELECTRIC STOVE

A REAL FIRELESS COOKER

ASK ABOUT IT

That is PRACTICAL and REASONABLE



The Comet Electric Stove is designed to save fuel. Cheaper than gas, coal or wood, no odor, dust or smoke.

Reasonable to buy—convenient to use—economical for the Home, Camp, Motor Boat, or Automobile. You don't have to depend on electricity alone—it's a fireless cooker as well.

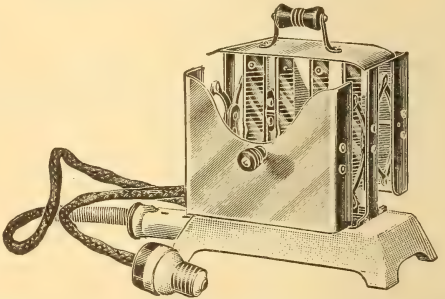
Ask us more about it now—today. Special prices to Central Stations and Dealers.

COMET ELECTRIC STOVE CO.

280-284 Eighteenth Street DETROIT, MICH.

MESCO TRADE MARK

Mesco Electric Toaster



Price with Cord and Attaching Plugs, complete, $5.00

Low Current Consumption.
Mechanical Heat Regulator.
Solid Porcelain Base.
Highly Polished, Nickel-Plated Brass.
Not the Cheapest, But the Best.

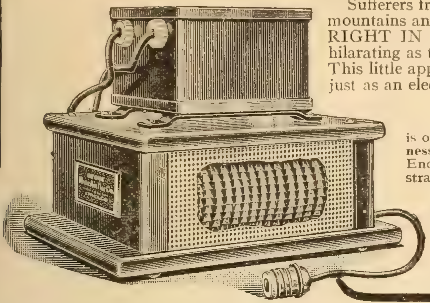
The adjustable doors that hold the bread can be placed close to the heat unit for making toast quick and crisp, or they can be withdrawn to the proper distance for making a hard brown toast. If doors are pulled out full distance the toast remains hot, but will not burn. The only Electric Toaster with this essential feature. Can be used on either direct or alternating current. Made for 110 to 220 Volt circuits. Also 220 to 250 Volt. **Ask for Catalog 24E.**

Manhattan Electrical Supply Co.

NEW YORK, 17 Park Place
CHICAGO, 186, 188 Fifth Ave.

MESCO TRADE MARK

Let Electricity Make Pure Air for You



Sufferers from many ailments travel thousands of miles to breathe the OZONE of the mountains and pine forests. Yet a recent scientific invention enables everyone to have—RIGHT IN THEIR OWN BEDROOM—air constantly as pure, refreshing and exhilarating as the purest oxygen-filled atmosphere of the piny woods and mountain peaks. This little apparatus is operated by electricity and "ozonizes" the air of the closest room just as an electric storm purifies the out-door air. The

OZONE PURE AIRIFIER

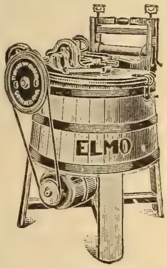
is of greatest benefit in the treatment of **Asthma, Hay Fever, Catarrh, Insomnia, Nervousness, Pneumonia, Typhoid and Scarlet Fevers, Diphtheria, Bronchitis, Tuberculosis, etc.** Endorsed by highest medical and scientific authoritiesa thoroughly tested and demonstrated success.

Central Station, Electric Jobber and Dealer, this is the latest Electrical Appliance on the market. Write now for illustrated catalogue, price list and descriptive matter and plan of placing for liberal trial.

We want distribution throughout the United States in Every Place Where Electrical Appliances are Sold.

OZONE PURE AIRIFIER COMPANY
307-314 Rand McNally Bldg. **CHICAGO, ILL.**

The Lid can be Raised While the Washer Runs



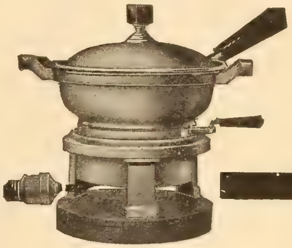
This exclusive feature of the Elmo Washer means quicker, more economical washing, and saves frequently stopping and starting the machine.

The lid is light and easy to raise. You don't have to lift a lot of heavy machinery. Besides

The Elmo

has positive action wringer, back gear drive principle—noiseless and power-saving, protected motor and other desirable features too numerous to mention here. We tell you all about them in our free booklet. Write for it and learn how a perfect washer works.

Grinnell Washing Machine Co.
GRINNELL, IA.
CANADIAN TRADE UPPLIED BY
THE GEM MOTOR CO.
419 Portage Ave., Winnipeg, Man.



No. 1203

THE ELECTRIC CHAFING DISH

adds a charm of its own to the "after theatre snack" or the social evening—appeals to those who do light cooking at any time. Convenience, cleanliness, absolute safety and low cost in operation as well as uniform dependability are features of the Simplex. No. 1203 shows the favorite "Mission" or "Crafts" Style appropriate in many homes. Leaflet of other styles or catalog of other Simplex Household Helps sent on request—or ask to see Simplex devices at your lighting Company's or dealers.

Simplex Electric Heating Co.
CAMBRIDGE, MASS.

CHICAGO
Monadnock Block

SAN FRANCISCO
612 Howard St.

BE CLEAN!!

YOU WANT

The "BEE" Suction Cleaner

IT *costs only $65.00 with complete equipment.*
weighs only 20 lbs. No Jar or Vibration.
equals the highest priced machines in efficiency.
does the best work with the least effort.
has new and exclusive features.

SOLD ONLY BY RELIABLE AGENTS
BIRTMAN ELECTRIC CO., CHICAGO, U. S. A.

IMPROVED SERVICE FOR ELECTRIC VEHICLES

Longer life, greater simplicity, absolute reliability;—these have been the features of an Electric Vehicle Battery which makers and users of "Electrics" have for a long time desired.

These results have now been accomplished. A new Electric Vehicle Battery has been developed far superior to any battery yet manufactured. It is the latest and highest development of the "Exide" Battery which has been so superior that over 90 per cent of all "Electrics" manufactured have been equipped with it. This new battery is

The "Ironclad-Exide" Battery

It has the following features of superiority:

1. **It gives from two to three times the life.**
2. **It rarely, if ever, requires cleaning.**
3. **It gives increased mileage.**
4. **It reduces the cost of operation.**

"Ironclad-Exide" Batteries can be installed in any jars of standard "Exide" size, so that vehicle users having such jars can substitute the "Ironclad-Exide" Battery when requiring renewals.

Users of "Electrics" should insist upon the "Ironclad-Exide" for renewals, and purchasers of "Electrics" that their car is equipped with the "Ironclad-Exide"

Learn all about this new and most up-to-date Electric Vehicle Battery by securing from any of our Sales Offices a copy of the "Ironclad-Exide" Book.

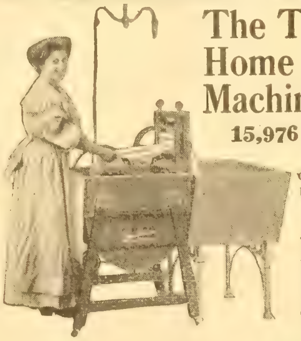
THE ELECTRIC STORAGE BATTERY CO.

1888 PHILADELPHIA, PA. 1911

New York Boston Chicago St. Louis Cleveland Atlanta Denver Detroit San Francisco Portland Seattle Los Angeles Toronto

"Exide" Depots in Philadelphia, Boston, Chicago, Cleveland, St. Louis and San Francisco

715 "Exide" Distributors BATTERY HELP OR INFORMATION FREE "Exide" Traveling Inspection Corps



The Thor Electric Home Laundry Machine

15,976 Now in Use.

Washes and wrings clothes at the same time.

Write for catalog.

Hurley Machine Company

1010 Flatiron Building
New York

Clinton and Monroe Sts.
Chicago

IRONING MADE EASY

Your bed and table linen, plain clothes, flat pieces, 80 per cent of family wash, can be ironed **Easier** (no backache or tired feet), **Quicker** (in 1-5 the time), **Better,** with finish far superior to hand work, by using the

SIMPLEX IRONER

"THE BEST IRONER"

1½ ct. per hour to heat by gas or gasoline. **Price within reach of all.** Sizes for small homes and large; operate by hand, or small washing machine motor. **Illustrated booklet** sent **free** on request. Write for our **30 day free trial offer** and nearest dealer.

American Ironing Machine Co., 25 E. Lake St., Chicago

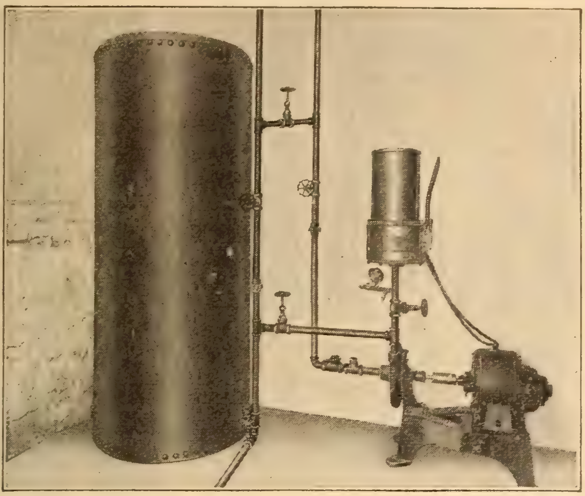
TESTED APPARATUS Means the Elimination of Faults in Your Product.

Electrical and photometrical tests of every description.
Checking electrical instruments of all kinds and classes.
Inspecting and testing new electrical machinery, apparatus and material at factories and after installation.
Tests on any electrical machinery and apparatus made anywhere.
Arc and incandescent lamp tests, either electric, gas, acetylene or oil.
Illumination tests made anywhere.
Secondary standards of candle-power furnished.
Facilities furnished to experimenters and investigators.

We have recently added to the above, coal testing, and are now prepared to make **proximate** analyses and calorific determinations on samples of coal, promptly and accurately.

ELECTRICAL TESTING LABORATORIES

80th Street and East End Avenue NEW YORK, N. Y.



"ECONOMY"

Automatic Electric Water System

will furnish an abundant supply of clean, areated water, without the use of a roof or large storage tank.

Will stand the most severe service for long periods of time without skilled care.

Installed in basement. Consists of a pump, direct connected by an insulated flexible coupling to an electric motor, an automatic switch and a pneumatic tank.

Water is pumped into tank against air pressure. When maximum pressure is reached the automatic switch opens and stops pump. When pressure is lowered, the automatic switch closes starting pump.

The pump is the centrifugal type and has no valves, gears or cams to get out of order.

Nothing complicated about the system. Any plumber or handy man can install by following instructions.

Especially adapted for schools, flat buildings, suburban homes, office buildings, hotels and factories.

Tell us your needs and we will be pleased to give you detailed information.

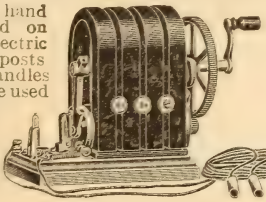
We also manufacture:—

Bilge Pumps—Sewerage Ejectors—Condensation Pumps and Receivers—Cellar Drainers Centrifugal and Triplex Pumps for all work—Hot Air Engines—Vacuum Cleaning Apparatus—Air Washers—Purifiers and Cooling Apparatus.

Watch for our ads telling you all about them.

THOMAS & SMITH, Inc., 116-118 North Carpenter Street, CHICAGO, ILL.

A Pleasing Gift For Boys



Large powerful hand Dynamo, mounted on oak base with electric lamp, connecting posts and cord with handles for shocks. Can be used for ringing bells, lighting lamp, etc.

Something practical and durable and guaranteed to be perfect.

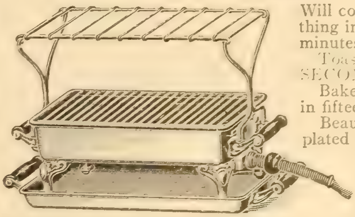
Send order today as we have a limited supply.

Special offer this month only $3.00

HOLTZER-CABOT ELEC. CO.

6161-65 S. State Street CHICAGO, ILL.

PELOUZE
STOVE-TOASTER AND GRIDDLE
WITH PLATE WARMER



Will cook most everything in less than FIVE minutes.

Toasts in forty-five SECONDS.

Bakes Griddle Cakes in fifteen seconds.

Beautifully nickle-plated throughout.

Very efficient and economical.

Price $10.00

Send for circular of irons and heating devices. Very economical. For sale by leading dealers everywhere.

Pelouze Electric Heater Co. 232-242 E. Ohio St., CHICAGO, ILL.

ROTH

ELECTRIC MOTORS
POLISHING LATHES
FORGE BLOWERS
SPECIAL MACHINERY

ROTH BROS. & CO.

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Chicago, Ill.

136 Liberty St.
New York City

ELECTRIC LIGHT AND POWER

DAY AND NIGHT SERVICE

The Junior No. 1 Equipment

Direct Connected Dynamo, Gasoline Engine Set. Complete Switchboard, 16-Cell "American" Storage Battery } $265

The most complete, reliable equipment ever offered at this price. We want a representative in every county.

AMERICAN BATTERY COMPANY

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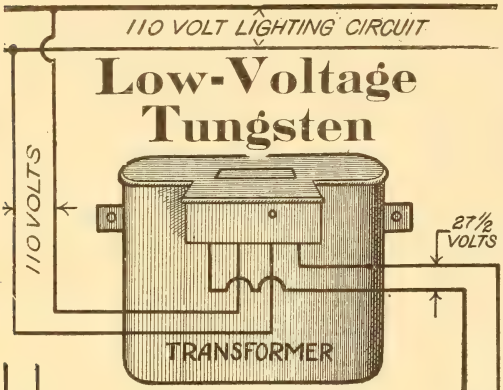
"Domestic" Electric Washer and Wringer

Oscillating, Self Cleaning, All Metal Tub, Reversible, Metal Frame Wringer, Positive Drive, Automatic Belt Tightener, Inclosed Working Parts. No Springs to Break.

SEND FOR BOOKLET

Domestic Equipment Co.

53 State St., Chicago



Low-Voltage Tungsten

Warner's Fifty Per-cent Saving System

27½ Volt Lamps

¶ Tungsten lamps for the ordinary 110-volt lighting current are necessarily made with long, thin filaments which are frail and liable to break.

¶ A low-voltage tungsten lamp, like the Warner Mazda lamp, has a short, thick filament which will stand any amount of jarring.

¶ The Warner system permits the use of these **efficient and economical low-voltage tungstens** in homes, stores, hotels, offices, etc.

¶ It consists of a small transformer into which the 110-volt current is passed through one pair of taps and out of which current at 27½ volts is obtained from another pair of taps.

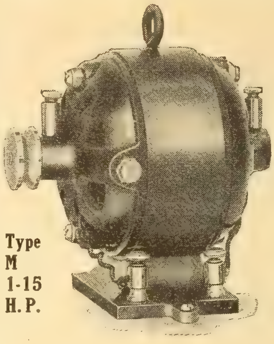
¶ This transformer, together with the Warner Mazda lamps constitutes all there is to the system.

¶ It is easily installed and means **plenty of clear, white light** at a much **reduced cost.**

¶ Send for our catalogue 600-P and tell us number and kind of lamp you are using.

Warner Arc Lamp Co.

Wilton Junction, Ia.



Type
M
1-15
H. P.

$3.50 FOR THIS High Grade MOTOR

Runs on a. c. and d. c. current, 110 *volts. Includes complete set of blue prints showing how to assemble. Has laminated field and armature, mica insulated commutator,* 3-16 *carbon brushes, bronze bearings, brass grease cups, pulley and terminals.*

Any bright boy can get valuable experience and at the same time STUDY MOTOR CONSTRUCTION WITH PRACTICAL WORKING MODEL. Many interesting experiments can also be performed such as winding so that IT WILL RUN AS A DYNAMO AND ON BATTERY CURRENT. Hundreds of these motors sold to ambitious Electrical Students during the last sixty days. The best small motor made for operating advertising devices, mechanical toys, jewelers lathe, etc.

This motor assembled complete ready to attach to any 110-*volt lamp socket,* $5.50.

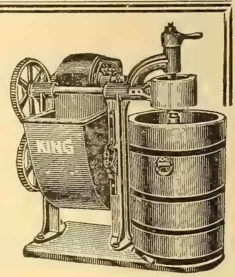
Send Express or P. O. money order.

JOSEPH WEIDENHOFF

Manufacturer Electrical Specialties

1215 S. Ashland Ave. CHICAGO, ILL.

The Dewsberry Electric Power Freezer



Will enable you to produce a better grade of ice cream at a lower price and in less time than by any other method.

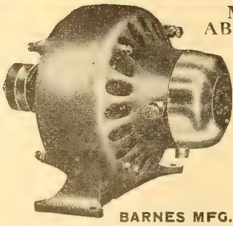
These machines are built unusually subtantial and are guaranteed to give satisfaction.

Made in 20 and 40 quart sizes. The 40 quart size runs both fast and slow on A. C. current. Write today for circular.

R. A. DEWSBERRY

216 N. Morgan Street : CHICAGO

1/12 AND 1/8 Direct and Alternating Current Motors VARIABLE SPEED - SINGLE PHASE



MOTORS THAT WILL ABSOLUTELY NOT HEAT

"The Barnes Motors" are especially adapted for Washing Machines, Vacuum Cleaners, Air Purifiers, Ventilating Devices, Coffee Mills, Meat Choppers, Printing Presses, etc., etc. —Dental and Medical work a specialty. Positively the best motor for use where motor driven work is necessary —greatest power, highest efficiency We want Reliable Agents everywhere —write at once for prices and catalog. Let us figure on your requirements.

BARNES MFG. CO., SUSQUEHANNA, PA.

This Kerosene Engine Cuts Your Expenses 75%

YOU should not even consider engines that operate on gasoline only. The rapidly rising price of gasoline, now 6 to 16 cents higher than kerosene, absolutely makes operation on this fuel too expensive. The Perfection Kerosene Engine operates on **any** engine fuel. When you purchase it you are on the safe side—proof against all fluctuations of the market. You can always run this engine at a great fuel saving and get the greatest amount of work done. The Perfection **vaporizes its own kerosene** and so makes it as efficient as gasoline—something other engines **cannot** do.

The Perfection is very light, portable, has only three moving parts, runs everything about the place, is lower in price than any other engine of its capacity on the market.

PERFECTION Kerosene Engine

Sent You on 15 Days Free Trial

See your dealer at once and ask him to let you have a copy of our **Free ENGINE BOOK,** which shows the sizes and styles of the "Perfection" and explains this very attractive offer. Your dealer will send any "perfection" engine to your farm for 15 days and let you return it if you are not satisfied. Ask him about it. If he does not carry the "Perfection" write to us and we will send you our **Free Engine Book** direct.

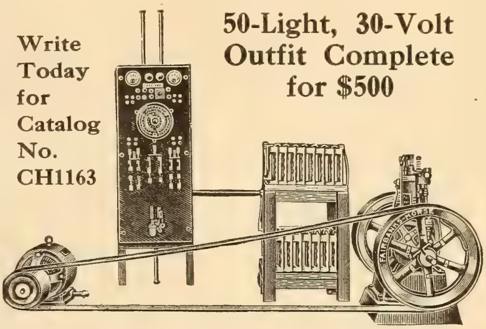
CAILLE PERFECTION MOTOR CO.
202 Second Ave., Detroit, Mich.

Operate Your Own Electric Light Plant

We furnish complete outfits that will give you all the light you need for your place at surprisingly low cost. Makes a light of great brilliancy—the most convenient and healthful light known. It is restful to the eyes and does not consume the life-giving oxygen in your rooms as do lamps or gas. Same engine runs water supply system or other machinery. Absolutely safe. Will last for years at very small maintenance cost. We also make larger electric light plants up to 500 H. P. in single units.

Write Today for Catalog No. CH1163

50-Light, 30-Volt Outfit Complete for $500



Fairbanks, Morse & Co.
481 Wabash Avenue Chicago, Ill.

Stop Paying for Marine Engine Experiments

Reputable agents wanted to handle popular-priced marine engine. **Absolutely guaranteed for 5 years. Thirty days' trial by the purchaser. Your money promptly refunded, without question, if you are not fully satisfied.**

A sure favorite and quick seller. Big returns assured. Simplicity the keynote of construction.

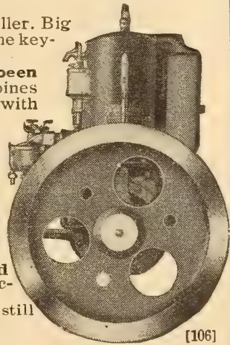
Just the engine you have been looking and waiting for. Combines the good features of the best, with all the bad ones eliminated.

Fool-proof. As near perfect as anything mechanical can be produced.

All sizes in stock from 2 to 50 h. p. Ready to ship on 24 hours' notice if necessary.

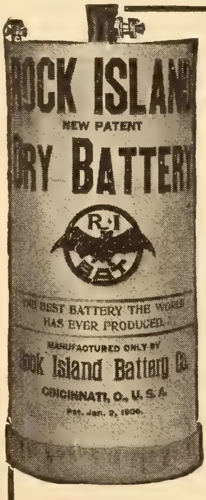
Details of the greatest selling plan and agents' money-making proposition ever offered. **Liberal discount, specified territory and absolute protection to accepted agents.**

Some very productive territory still open.



Write today for Catalog No. 28 [106]

COLUMBIA ENGINE COMPANY
Cor. Jefferson and Bellevue Aves., DETROIT, MICH.



Popularity

THERE'S one never-failing characteristic about the **hand made**

ROCK ISLAND DRY CELLS

They give the satisfactory service which holds **old** users and enlists **new** advocates.

They LAST LONGER

Proved best on every test, these batteries are good for **all** electrical purposes and are unsurpassed in ignition work.

PRICE 25 CENTS

Write TODAY for our Battery Booklet N—FREE

The Rock Island Battery Co.
Winton Place Station, Cincinnati, Ohio

The Chapin Co., Calgary, Alb., Canada
Distributers for Alberta

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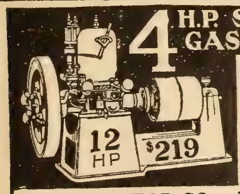
4 H.P. STATIONARY GASOLINE ENGINE COMPLETE $76.00



For Farmwork, Irrigation or Pumping, Factory use and Electric Lighting.

3 to 20 h.p.—perfectly governed —guaranteed by a responsible firm. Write for full description.

GRAY MOTOR CO., 128 Leib St., DETROIT, MICH.

SPECIAL

WE have a quantity of perfectly good *ENAMELED WIRE* that we will sell at a sacrifice.

This wire was coated with enamel made according to our old formula. We don't offer it as standard stock, but we do recommend it for all ordinary windings and especially for WIRELESS WORK.

There is a good assortment of sizes. Reservations of stock will be made in the order in which inquiries are received until stock is exhausted. ☞ *WRITE FOR PRICES ON THE SIZES YOU NEED.*

AMERICAN ELECTRIC FUSE CO. Dept. W. MUSKEGON, MICH.

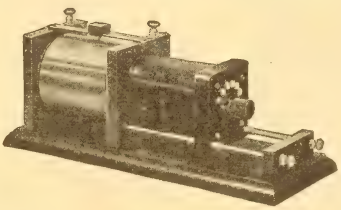
Wireless Receivers

Our long experience in manufacturing all kinds of receivers for telephone use, has made us specialists in WIRELESS RECEIVER work. Our special magnet steel, sensitiveness of operation, durable construction, places our wireless receiver set far ahead of anything manufactured in the country.

Mention Popular Electricity when writing.

THE HOLTZER-CABOT ELECTRIC CO.
Chicago, Ill. Brookline, Mass.

MURDOCK WIRELESS APPARATUS



DESERVEDLY

the most popular receiving transformer available at a moderate price. Distinguished by its thorough construction, its sensitiveness, its selectivity. So far superior to instruments of similar purpose and relative price, that there can be no comparison.

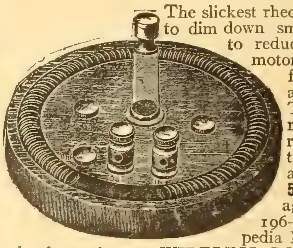
PRICE - $15.00

We MANUFACTURE every requisite for complete installations of wireless telegraphy, and will be pleased to correspond with individuals or corporations contemplating its use.

Wm. J. Murdock Co.
50 Carter St., CHELSEA, MASS.
182 Minna St. San Francisco
221 So. Clinton St. Chicago

The "Electro" Rheostat Regulator

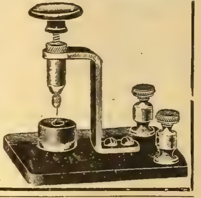
(Patented)



The slickest rheostat ever manufactured to dim down small incadescent lamps; to reduce the speed of small motors, to regulate current for Electro Plating work, and hundred other uses. The only rheostat that raises or cuts down current gradually. Resistance 10 ohms, carries 2 amperes. **Price, prepaid, 50c.** Send 4 cents postage at once for our great 196-page electrical cyclopedia No. 9, containing hundreds of experiments, WIRELESS GOODS, etc.

The Electro Importing Co.
233 B FULTON STREET - NEW YORK CITY
"Everything for the Experimenter"

Long Distance Work



can only be done with good and sensitive instruments. Our goods embody both these qualities. Use our Electrolytic detectors shown in cut for fine work. We are this month sending out this instrument with 2 inches of Wollaston wire prepaid for $1.50. Send 3c for large catalogue. **FRANKLIN ELECTRIC NOV. & MFG. CO., 846 Ninth Ave., New York, N. Y.** Branch, Biloxi, Miss. Levey Electric Co., San Francisco, Cal., Western Agts.

ELECTRIC

GOODS FOR EVERYBODY. World's headquarters for Dynamos, Motors, Fans, Toys, Railways, Batteries, Belts, Bells, Pocket Lamps, Telephones, House Lighting Plants, Books. If it's electric we have it. *Undersell all.* Fortune for agents. Big Catalogue 4 cents. **OHIO ELECTRIC WORKS, CLEVELAND, OHIO,**

No More "Battery Trouble"

Cease sending for the electrician to "fix that bell." Let the electric light current ring your annunciators, burglar alarms, etc. Our

"Junior" Transformer

will do it more cheaply than any other way. It uses scarcely any current, and can't be damaged by short circuits. Fireproof and durable. **Price $3, at dealers or direct from us.**

THORDARSON ELECTRIC MFG. CO.
214 Jefferson Street CHICAGO

Brooklyn Wireless "Mark of Quality" Be Wise

No. 8-14 Aluminum Aerial or Helix, or No. 14-22 Enameled Wires per pound	$0.50
No. 14-22 Bare Copper Wire per pound	.40
Stranded Galvanized Guy Wire per 100 feet, $0.35, Turn Buckles Rach	.10
"Bwaenco" Universal Mineral Detectors Adjustable (for any Mineral)	1.00
"Bwaenco" Spark-Gap Adjustable, $0.35, Geissler-Tubes-3-inch Liquid'	.20
"Bwaenco" Non-Inductive-Potentiometer, $0.75, Potentiometer-Rods'	.15
"Bwaenco" Tuning Coils, Double Slide, $1.50 Single Slide	1.25
"Bwaenco" 410-Fixed-Condenser (Box-Shape-outside dimensions, 6½x4¾x1½)	.65
"Bwaenco" 409-A-Variable "Tubular-Rotary-Type-Seamless Brass Tubing	2.00
"Bwaenco" ½-K. W. Transformer with Fine Vibrator, $9.00; without Vibrator	6.50

BROOKLYN WIRELESS CO., 766 Broadway, Brooklyn, N. Y.

ENAMEL INSULATED FRENCH Feval PROCESS **MAGNET WIRE**

ENAMEL WIRE is supplanting silk and cotton covered because **The Insulation is better,** because **It requires less space,** because **It is cheaper.**

FEVAL WIRE has a dielectric strength in excess of 75 volts per .0001 inch of insulation. The evenly distributed enamel covering adheres tenaciously yet is resistant and elastic, never cracking. No change at 400° to 500° F. All sizes, Nos. 16 to 40.

MANUFACTURERS: We have an attractive contract proposal to offer covering your requirements for 12 months.

INDIVIDUALS: We will furnish small quantities for spark coils and magnets.

FEVAL ENAMEL INSULATED WIRE CO.
129 N. Curtis Street CHICAGO

SECONDARY "UNITS"

Been having trouble winding your Secondary for your Induction Coil or Transformer? Why not put your worries on our shoulders? The winding is not a WORRY to us, as we have the equipment, and winding coils is a part of our BUSINESS.

Our Secondary "UNITS" are wood spool sections wound, parafined, etc., and all ready to connect up. You can buy a spool at a time or as many as you want, and they will cost you but little more than the wire alone,

Send 2-cent stamp for our large catalogue which tells all about it and many other things "WIRELESS" besides.

Dawson & Winger Electric Co.
429 Dearborn Street: Chicago, Ill.

WIRELESS TRANSFORMERS

1-2 K. W.
$30.00

Send for Catalogue

E. S. RITCHIE & SON, 117 Cypress St., BROOKLINE, MASS.

Can You Beat This?

2000 Ohm Leather Headband Set $4.50

I SAY YOU CAN'T

Better than anything on the market at this, and even at a higher price.

LET US PROVE IT

Receiver only, 1000 ohms, $1.50. Postage 10c

C. BRANDES 111 Broadway, New York

WIRELESS COILS

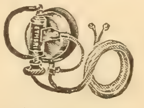
No. 1—	1-4 in. to 3-4 in. spark	$3.50
No. 2—	3-4 in. to 1 1-4 in. spark	4.50
No. 3—	1 1-2 in. to 2 1-2 in. spark	9.00

These high-grade guaranteed coils are not over-rated.

Send your money and coil will be shipped to you same day. Thousands of them in use.

LEMKE ELECTRIC CO., Dept. P. E., Milwaukee. Wis.

NEW WIRELESS WONDER



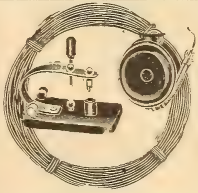
Aero-Field Receiving Outfit. Weight only 4 oz. Receives up to 75 miles. The Wireless Sensation of the year. Consists of 1000 Ohm, receiver and attachments all assembled on regular size leather insulated head band. Price $4.00 (not including light field aerial). A wonderful instrument at a wonderful price. Boy scouts and all requiring light outfits send 2c for description of the Aero and catalogue. **Etheric Electric Co.**, Salesrooms and Factories, 278 Lenox Ave., cor. 124th St., 71 Barclay St., New York, N. Y.

WIRELESS APPARATUS

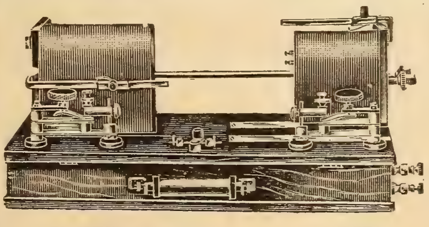
Our Wireless Goods are the best on the market, and are guaranteed to *work*. Our instruments are made of the finest materials, and are sold at present at a price within the reach of every experimenter. Send 2c stamp for our large catalogue which contains a full list of Wireless Instruments, Novelties and Electrical Goods, and also a great deal of Wireless information for the Wireless experimenter.

The I. W. T. Wireless Co., 726½ Broadway, Brooklyn, N. Y.

Everybody Can Own A Wireless



We are this month offering an exceptional bargain in our new Wireless Receiving Set consisting of a combination **Electrolytic & Mineral Detector, 90 Ohm Nickeled Receiver, 3 ft. silk cord, 65 ft. aluminum wire and diagrams.** 300 to 500 miles guaranteed. 1 inch finest Wollaston Wire furnished. Price, $1.40, postage 16c extra. Send stamp for catalogue. **THE HERTZIAN ELECTRIC CO., 3316 Avenue L, Brooklyn, N. Y.**



No. 6040, price - - $40.00
Complete Set, unmounted 29.00

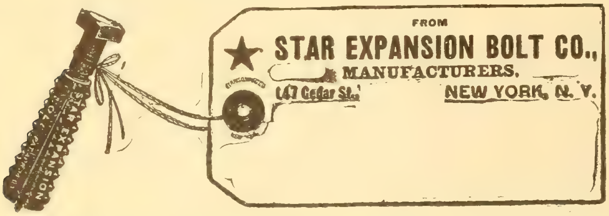
BIG 200 Page Electrical Catalog

The Greatest Line of Wireless and Electrical Goods Extant

Send 4c stamp (to cover postage only) for this catalog, deducting same, if desired, from first order.

One of our patrons from California voluntarily writes as follows: "I think that it is only right for me to express my appreciation to you for the receiving set No. 6040 that you supplied me with some two weeks ago. I have never seen anything that can be compared to it. **I have received messages from stations sixteen hundred miles distant,**—on three occasions **I picked up Honolulu in the Hawaiian Islands** and heard signals very clearly," etc.

J. J. DUCK, 428 St. Clair Street **TOLEDO, OHIO**



Put Your Name On This Tag!

MAIL THIS AD TO US and we'll send you our FREE SAMPLE SET of STAR EXPANSION BOLTS and SEBCO SCREW ANCHORS, together with our beautifully bound seventy-page catalogue No. 10 of specialties.

Tear this ad out and MAIL IT NOW to

STAR EXPANSION BOLT CO., Catalogue Department 10 **147-149 Cedar St., NEW YORK CITY**

Star Hack Saw Blades

No 10 ★ MFD BY MILLERS FALLS CO

are highest in quality and lowest in price. These two features work well together. The blades which we are now turning out are the best we have ever made. You can satisfy yourself that this statement is no exaggeration by remitting to us 34c. for a sample dozen of 8-inch, or 42c. for 10-inch, or 50c. for 12-inch. Postage free.

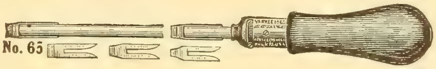
MILLERS FALLS COMPANY
26 Warren St., - New York, N. Y.

YOU'LL WANT MORE

"Yankee" Tools

WHEN YOU SEE THE LINE

35 STYLES 75 SIZES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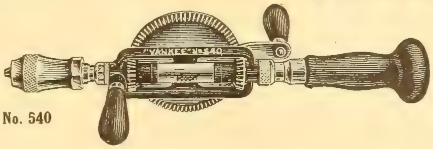


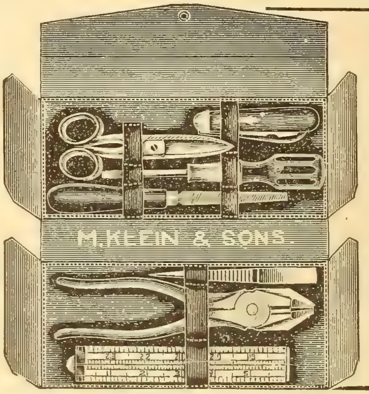
No. 540

SEND FOR OUR BOOK OF LABOR SAVERS

Tells all about them. A postal brings it.

Your dealer sells the "YANKEE."

NORTH BROS. MANFG. CO.
DEPT. C PHILADELPHIA, PA.

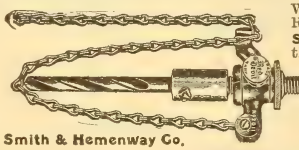


Every Tool

in this Kit a first necessity to Mechanic Inspector, Lineman. In sight, in place, ready for action. Write for descriptive folder on Kit No. 403H.

Mathias Klein & Sons
Station U-3, Chicago

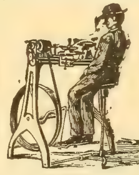
Genuine "Red Devil" Self Feeding Chain Drill



Will drill Iron, Steel or Rock with bit brace.

SPECIAL OFFER:—Cut this out and send to us with $1.50. We will **deliver** this drill to your nearest Express Office.

Smith & Hemenway Co. **150 Chambers Street**
New York City

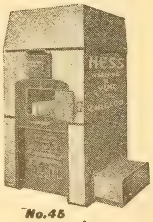


FOOT AND ELECTRICAL DRIVEN
Power and Turret Lathes, Planers, Sharpeners, and Drill Presses.

Write today for our Complete Catalog.

Shepard Lathe Co.
B. 131 W. 2nd St., Cincinnati, Ohio

HESS Sent on Approval **FURNACE**



No. 45 "Leader" Hess Steel Furnace Price $49
Delivered East of Omaha and North of Ohio River
Pipes and Registers Extra

We will deliver a complete heating equipment at your station at factory prices and wait for our pay while you test it during 60 days of winter weather.

The entire outfit **must satisfy you** or you pay nothing. Isn't this worth looking into? Could we offer such liberal terms if we didn't know that the **Hess Furnace** excels in service, simplicity, efficiency, economy?

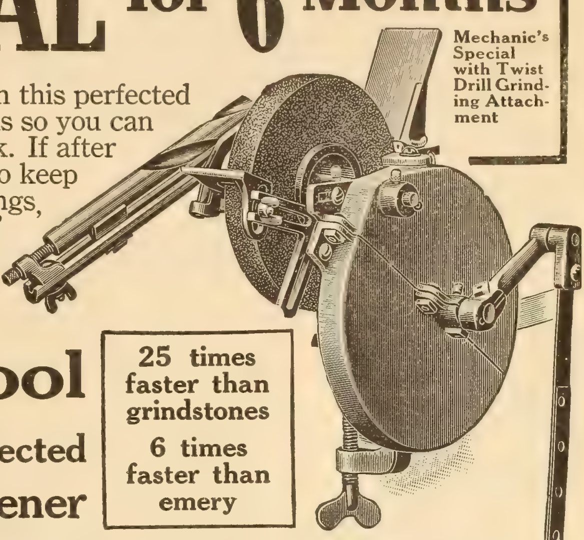
We are makers—not dealers—and will save you all middlemens' profits. No room for more details here. Write today for **free** 48-page booklet which tells all about it.

Your name and address on a post card is sufficient.

HESS, 912 ***Tacoma Bldg., Chicago***

FREE TRIAL for 6 Months

We want you to grind your tools on this perfected carborundum grinder for six months so you can find out its great value in your work. If after six months' trial you decide not to keep it, return it to us—no hard feelings, just send it back. The six months' use will have cost you nothing.



Mechanic's Special with Twist Drill Grinding Attachment

Luther Diamond Tool Grinder The Perfected Carborundum Sharpener

25 times faster than grindstones

6 times faster than emery

25 Times Faster Than Grindstones

This **Luther Grinder** — the standard of the world — with its wheels of the wonderful abrasive **carborundum,** is 25 times faster than grindstones. It cuts the hardest steel as emery does copper. One man with the Luther does the work of 20 men with any other sharpening device. Does not draw temper. No need of hard pressing — just a light touch — the hard, sharp carborundum crystals of the wheels peel off steel in tiny shavings. No water needed.

Return This Coupon and get our 6 months Free Trial Offer

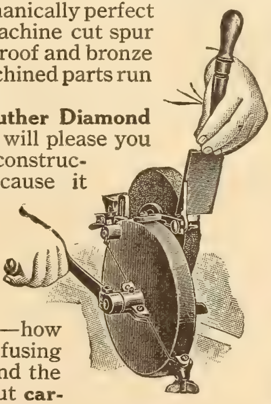
Send for our 6 months' free trial offer—we will also send you free a booklet telling the interesting story of the discovery of carborundum—how a scientist, attempting to make artificial diamonds, and fusing the elements of diamonds in an electric furnace, hot beyond the measurements of science, discovered, not the diamond, but **carborundum**—the wonderful abrasive that will scratch the diamond itself and cut steel as emery does copper.

Foot and Hand Power Equipped with Sharpening Attachments

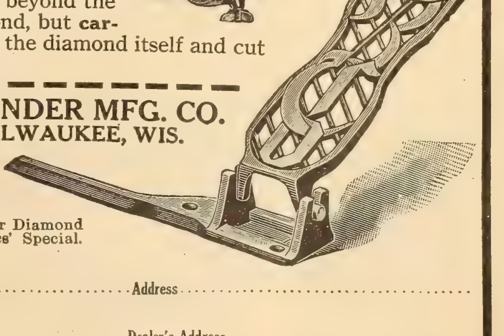
The special sharpening attachments enable anyone to do the most difficult sharpening, such as sharpening twist drills, chisels, plane bits, etc.

Luther Diamond Tool Grinders are the standard grinders of the world. In addition to their wonderful carborundum wheels, that never need dressing, they are mechanically perfect machines—machine cut spur gears—dust proof and bronze bearings—machined parts run in bath of oil.

In short, a **Luther Diamond Tool Grinder** will please you by its solid construction, and because it makes it easy to have keen edged tools without drudgery.



Hand Power Mechanic's Special with Attachment



Send coupon for our 6 months' free trial offer today.

Sending this coupon puts you under no obligations. Fill in your name at once and return coupon **now** while it is on your mind.

LUTHER GRINDER MFG. CO.
62 Madison Street
MILWAUKEE, WIS.

LUTHER GRINDER MFG. CO.
62 Madison St., MILWAUKEE, WIS.

Please send me free and prepaid your free carborundum booklets and your six months free trial offer on the Luther Diamond Tool Grinder Mechanics' Special.

Name.......................................Address.......................................

Dealer's Name.......................................Dealer's Address.......................................

MEN-GET THIS MONEY $30,000 IN 9 MONTHS

$13,245 IN 110 DAYS

Amount of orders from **R. V. Zimmerman, Ind. farmer** (*address upon request*) for our

NEW HOME INVENTION

First experience as a general or local agent, **M. Stoneman, Neb. artist** (*address upen request*) **spare time** orders total **Over $15,000**

One order exceeds $6,000. **"Best thing ever sold.** Not one complaint from 2,000 customers." **C. A. Korstad, Minn.** (*Address upon request*). **ORDERS $2,212 WORTH IN 2 WEEKS.**

Hundreds enjoying similar prosperity. Agents breaking all records—actually getting rich. **Let us refer you to 10 more whose total orders exceed $51,000;** to hundreds like **O. Schleicher, Ohio (minister)**, whose

FIRST 12 HOURS WORK SOLD 30 OUTFITS (PROFIT $81.90)

A. Wilson, Ky., who ordered **$4,000** worth and sold **102 in 14 days**, (profit $278.40): **J. Hart, Texas, $5,000** worth and sold **16 in 3 hours**) profit $43.68); **Reese, Pa., (Carpenter)** solicited 60 people—sold 55; **Beem, Kans.**, writes: **"I averaged $164.25 weekly for 3 months"**; Langley, N. D., sold **$115 worth first day.** Why should not Cashman say: "Men who couldn't sell your goods couldn't sell bread in a famine." **Reader**, these results possible for **you** at home or traveling all or spare time as **exclusive agent for Allen's Wonderful Bath apparatus.**

R.V. Zimmerman

M. Stoneman

New—Powerful—Irresistible

Think of it! **Gives every home a modern bath room for only $6.50,**—abolishes tubs, bowls, buckets, wash rags, sponges. Supplies hot or cold water in any room. **No plumbing—no water works—self heating**—makes bathing **5-minute** operation—easily carried from room to room—child operates easily. Means no more cold rooms. drudgery, lugging water, filling tub emptying, cleaning, putting away. No wonder **agents without previous experience make small fortunes, buy homes, have an automoble, bank account;** average 8 orders to every 10 families. Fascinating, dignified, exciting work. **No competiton**—patent new—field unworked—demand enormous—price insignificant—a demonstrated gigantic success—**everytning ideal for making money.**

Don't hesitate—business supplies capital

Be first. Get exclusive rights. Spare time gave **Oviatt, Iowa, minister, $800 in 11 days, $4,000 to date.** Reads like fiction, yet we prove all by affidavits, addresses, any proof you want. Address postal **today** for full details.

We started these men plus hundreds of others. They investigated—accepted—**made thousands.** Do as they did—make what they made.—Send postal—get our amazing offer—it's free.

FREE $13.75 AGENTS' OUTFIT TO ACTIVE AGENTS. CREDIT GIVEN ON SALES

ALLEN MFG. CO.,

3284 ALLEN BUILDING **TOLEDO, OHIO**

"Lucky I answered ad. It's great. Money coming fast. 17 orders today."—A. L., of Maine.

$11.50 FOR THIS

Lowdown Washdown Combination

The best and most sanitary closet on the market. Deep seal syphon action washdown vitreous china bowl, solid oak, copper lined tank, seat attached to bowl with nickel-plated hinges, brass nickel-plated supply pipe and two inch flush connection.

35 to 70% Saved on Everything in Plumbing and Heating

Iron enameled kitchen sink, sink and back cast in one piece	$9.00
Porcelain-enameled lavatory, complete with nickel-plated faucets, and nickel-plated trap	$7.00
Complete three-piece porcelain enameled Bath Room outfits	$24.95

Complete Water System for Country Homes

Write for Catalogue No. 11 today—It's a money saver.

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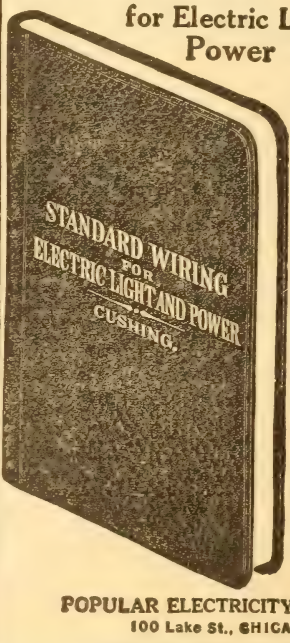

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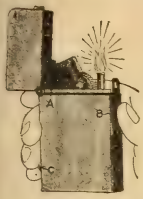

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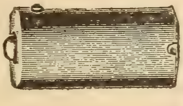

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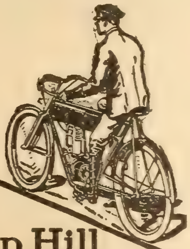

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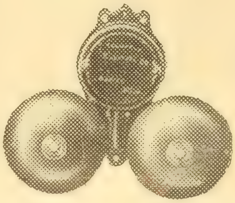

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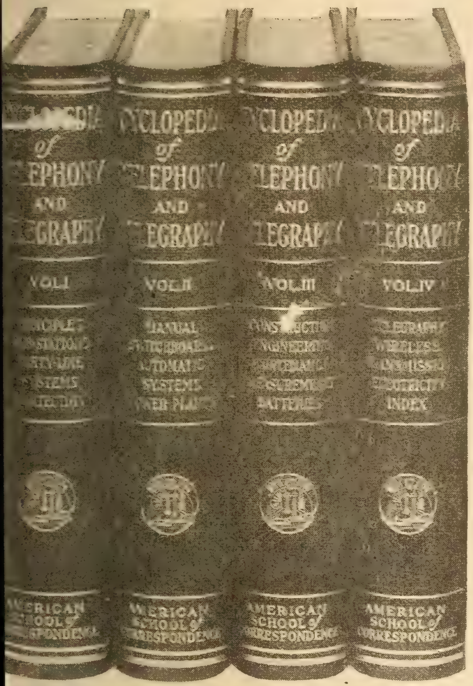

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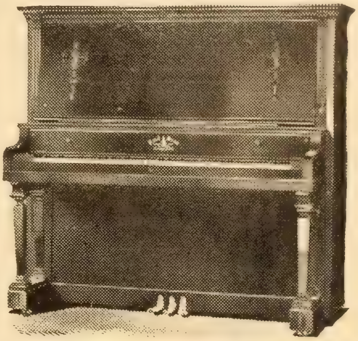

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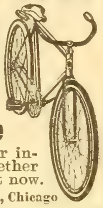

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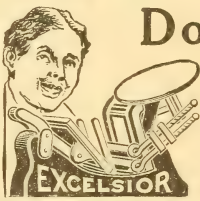

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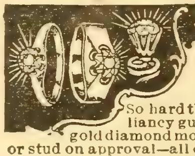

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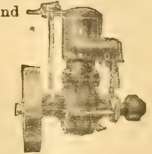

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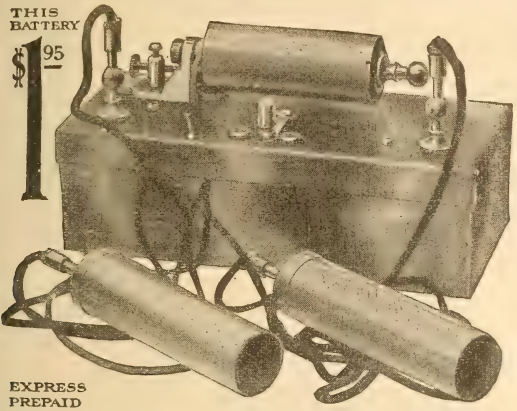

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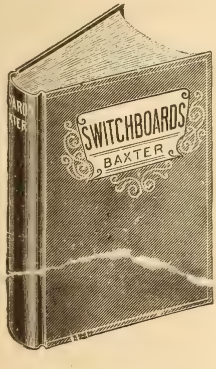

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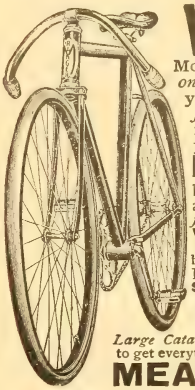

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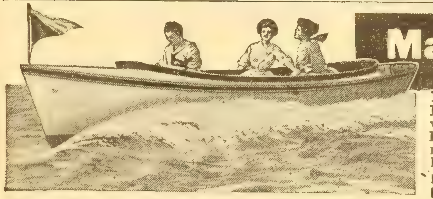

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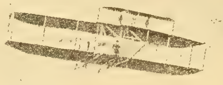

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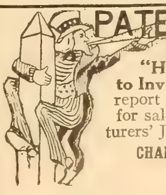

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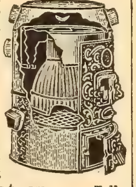

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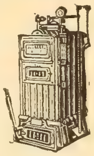

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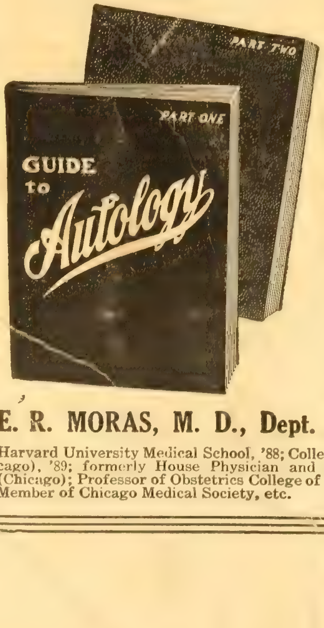

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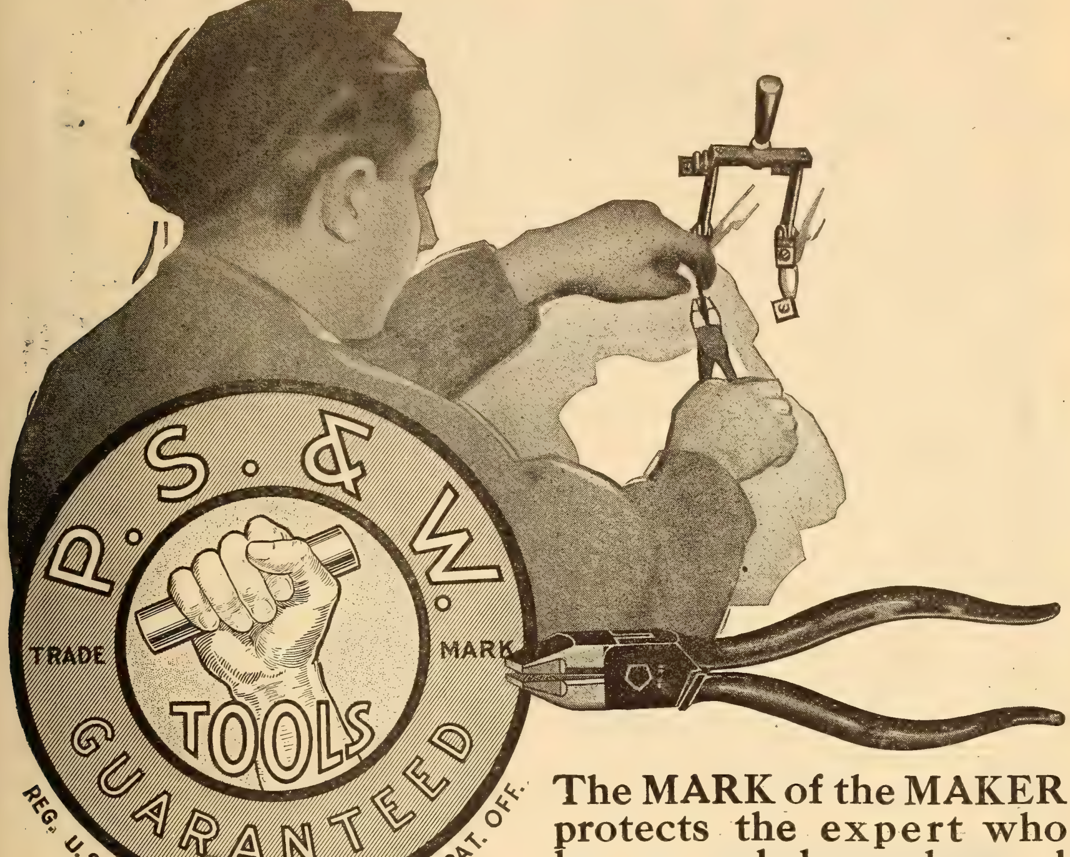

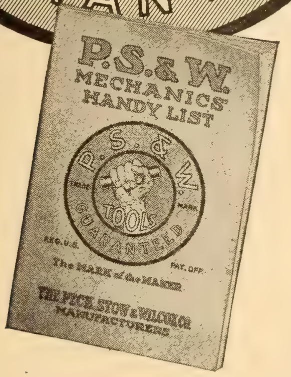

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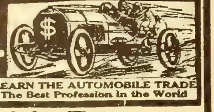

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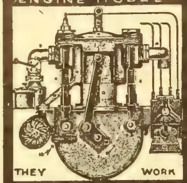

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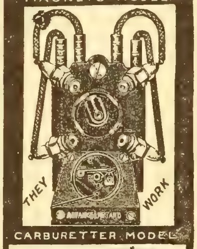

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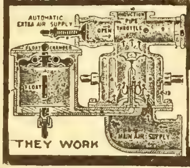

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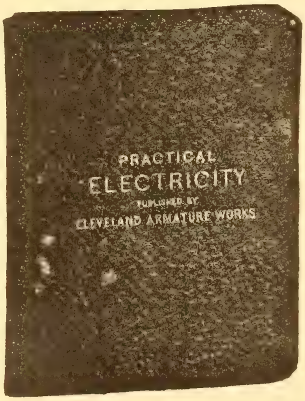

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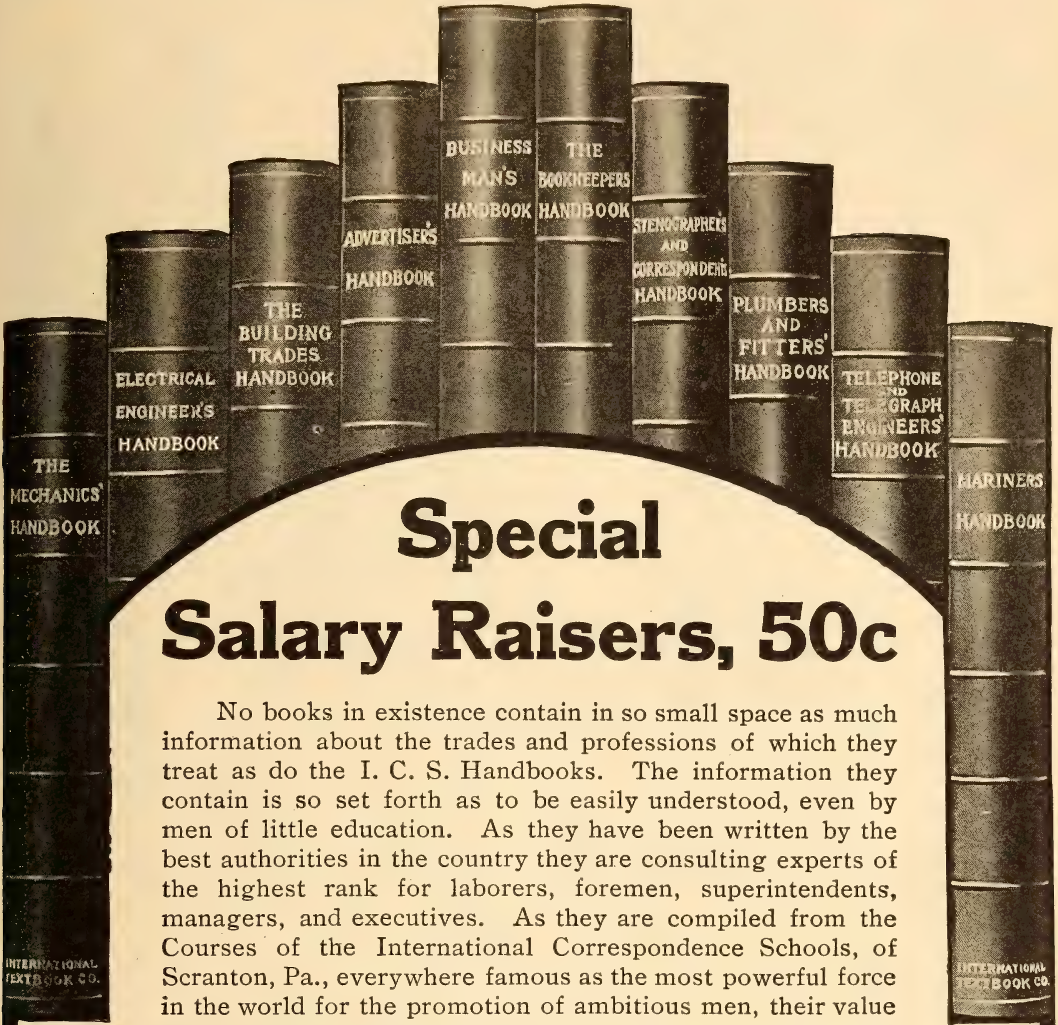
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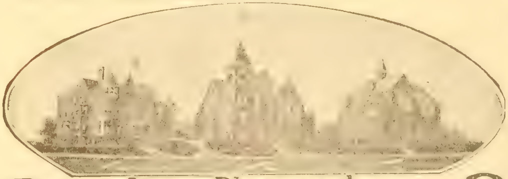

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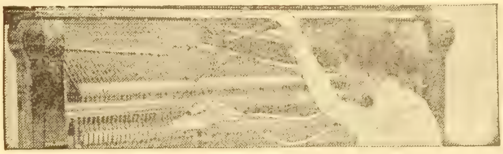

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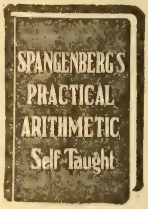

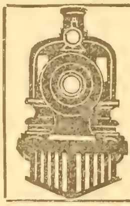

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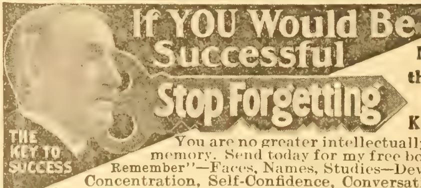

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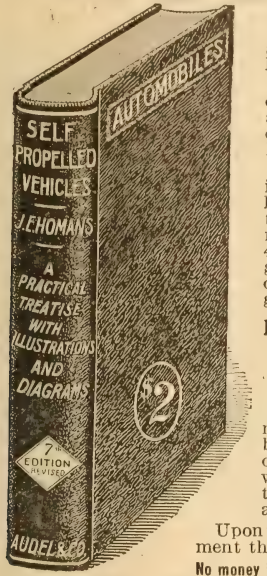

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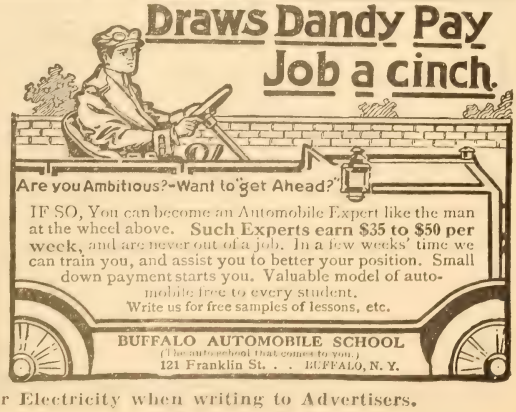

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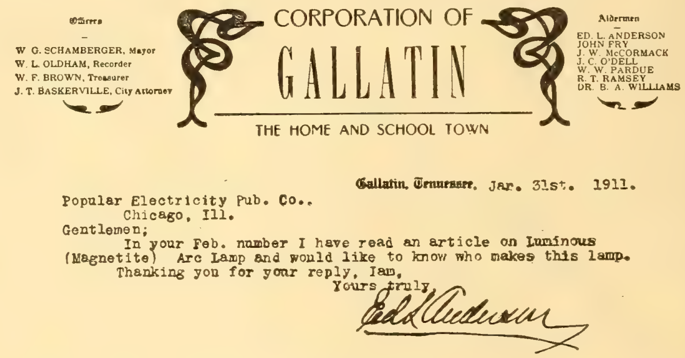
In the February issue we printed a brief article describing this lamp. The result was a number of letters of inquiry concerning it. Here is one of them:



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Gallatin, Tennessee, Jar. 31st. 1911.

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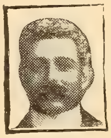
$3,000 in 30 days to Wilson (a banker).
$1,685 in 73 days to Rasp (an agent).
$800 in 11 days and **$4,000** to date, received by Oviatt (a minister).
$2,800 to Rogers (a surveyor).
$6,800 to Juell (a clerk).
$2,200 to Hoard (a doctor).
$5,000 to Hart (a farmer).

Rev. C. Miller

R.V.Zimmerman

M. Stoneman



M. Juell

These are just a few—hundreds sharing similar prosperity. Reads like fiction, yet it's the gospel truth. **Proven by sworn statements—investigation—any proof you want.**

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Sectional View

Beem writes: I averaged

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Wilson sold **102 in 14 days;** Hart **16 in 3 hours;** Langley **$115 worth the first day;** Reese solicited **60 peorle—sold 55.** No wonder Cashman says: "Men who couldn't sell your goods couldn't sell bread in a famine," and Lodewick "Lucky I answered ad; it's great; **money coming fast, 17 orders today.**

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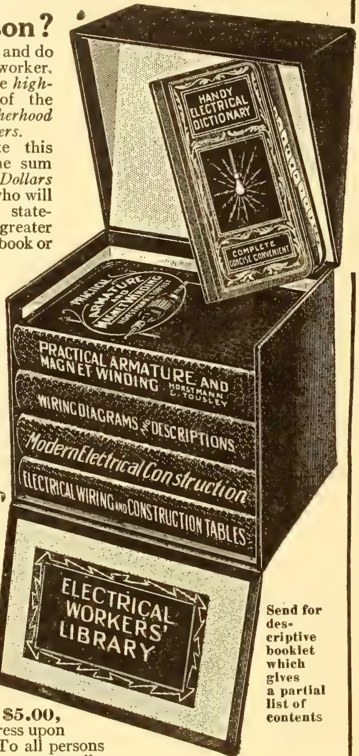
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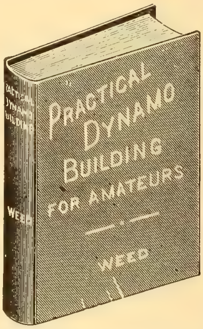
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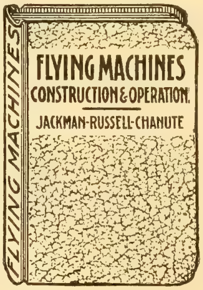

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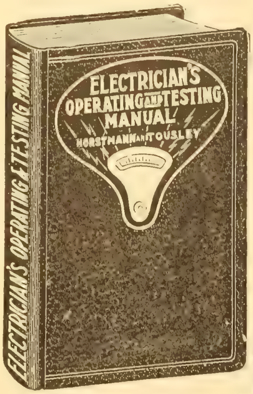
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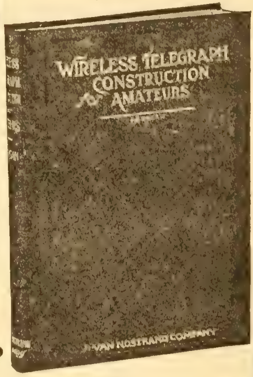

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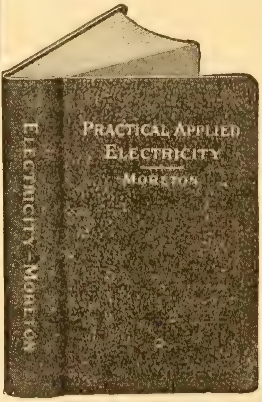

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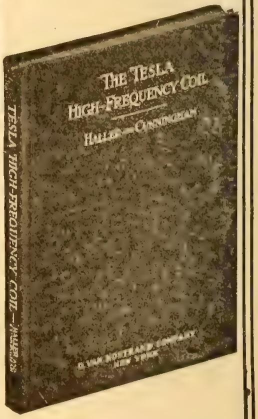
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Vol. III April, 1911 No. 12

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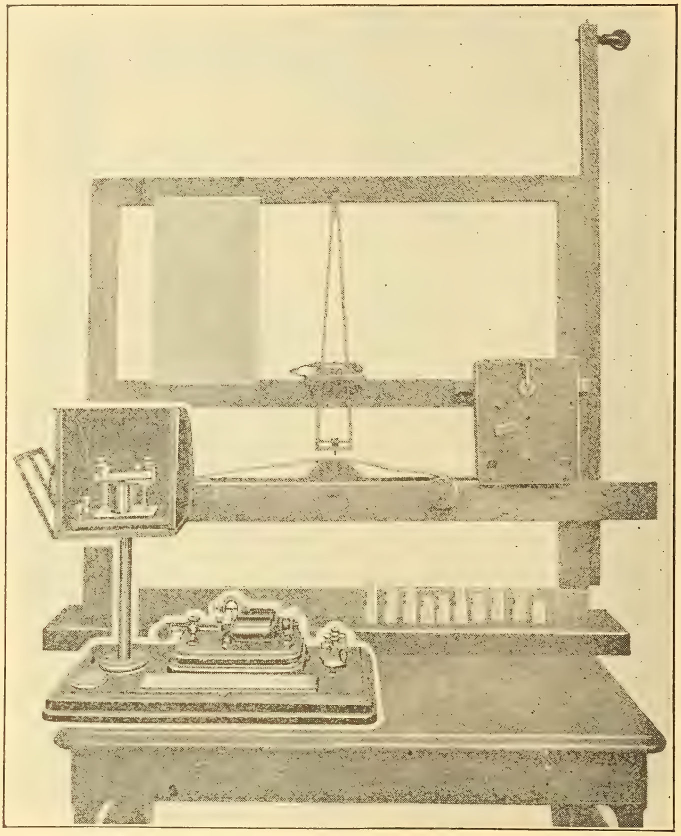

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Popular Electricity
In Plain English

Vol. III April, 1911 No. 12

Five Epoch-Making Electrical Inventions

By ELMER E. BURNS

What were the greatest electrical inventions? When this question is asked, and we cast about among the thousands of ways in which electricity is applied, five things stand out from all the rest. First in chronological order comes the telegraph; next the discovery of electric motor and its application to electric traction; then the telephone; the electric incandescent lamp, and, finally, the wireless telegraph. In this series of five articles Mr. Burns will relate the fascinating stories of these five great inventions, all of which are fraught with that element popularly termed "human interest."—Editorial Note.

I. The Telegraph

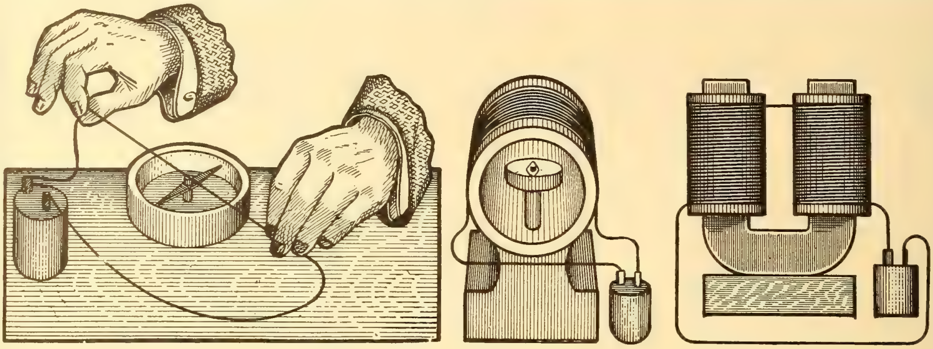
If you had mentioned the telegraph in a conversation with any intelligent person in the year 1840, he would have asked at once: "Which telegraph?" The word telegraph would have suggested to his mind not a wire carrying an electric current with sending and receiving instruments at either end, but it would have suggested, among other things, a system of semaphore signals similar to those used in certain forms of the railroad block signal system. France had the most extensive system of telegraphs of this kind in the world, five great lines extending from the capital to the extreme cities of the kingdom, a total distance of nearly 15,000 miles with a semaphore for every three miles. The signals were operated by human hands and caught by human vision. This system of telegraphs was maintained by the government at a cost of over $200,000 per year.

The need of some method of conveying intelligence to a distance was keenly felt and this clumsy method was the best that was then known. Certain forms of electric telegraph had been invented but these were expensive to install and uncertain in operation. So it happened that when Morse filed his application for a patent on his electro-magnetic telegraph, he did not claim the telegraph as a new invention but claimed "certain new and useful improvements in the telegraph."

It is true of the telegraph as of many other great inventions that a little knowledge leads us to give undue honor and applause to one fortunate inventor while a deeper knowledge leads us to recognize the contributions of many minds and give honor to whom honor is due.

The Franklin Institute of Philadelphia reported to Congress that the time required to make signals with the Morse telegraph was "at least as short as that of the common telegraphs," referring to the semaphone and other visible signal systems.

Benjamin Franklin was the first to conceive the idea of telegraphing by means of electricity and leave a record of his idea for the benefit of later investigators. He tried the experiment with four miles of wire, but the electric battery was then unknown and the discharge from an electrical machine or a Leyden jar could not be used for a practical telegraph. The invention of the electric battery revived the idea of an electric telegraph. Every known method of producing an electric current or a static electric charge and every known effect of an



Experiment of Hans Christian Oersted showing the magnetic effect of an electric current

Ampere's Idea of the needle telegraph

Professor Henry's electro-magnet

THE THREE FUNDAMENTAL EXPERIMENTS, THE PERFORMANCE OF WHICH MADE POSSIBLE THE TELEGRAPH

electric current up to the time of Morse's invention had been used in attempts to invent a telegraph. No success was possible, however, until the electro-magnet had been discovered and perfected.

The magnetic action of an electric current was discovered by Hans Christian Oersted, a professor in the University of Copenhagen, Denmark, in the winter of 1819–20. It was known that a stroke of lightning sometimes magnetizes steel knives or other steel objects that are in its path, and it was expected that an electric current would produce some magnetic effect if only the current were used in the right way. Oersted, after seven years of untiring work and many failures, one day while lecturing to his class thought to place the wire carrying the current in a north and south direction over a compass needle. He was surprised to see the needle swing round and point nearly east and west. When he changed the direction of the current still holding the wire north and south the needle swung round in the opposite direction and again pointed nearly east and west.

If the current were flowing toward the north the needle would turn so that the north pole pointed nearly west. If the current were flowing south over the needle the north pole would point nearly east.

In a few months a Frenchman named Ampere learned of Oersted's discovery and it occurred to him that here was the germ of an electric telegraph. If a long wire could be used and a current passed through this wire and through a coil around a compass needle then the circuit could be made and broken or the direction of the current reversed at the one end of the wire and the needle at the other end would swing to and fro and the movements of the needle might be arranged to indicate the letters of the alphabet and so convey a message.

A number of "needle telegraphs" were invented on the principle suggested by Ampere. Some of these were used commercially. The Cooke and Wheatstone needle telegraph was used in England as late as the year 1870. Inventors found difficulty, however, in making the telegraph work over long distances. Barlow in 1824 claimed to have demonstrated that the telegraph could never be made a commercial success. This prediction would have proven to be correct if no further discoveries in electricity or electromagnetism had been made. With a wire many miles in length the current was so weak that the magnetic effect was almost imperceptible. Two facts were yet to be discovered that would seem extremely simple even to the novice in electrical work today. We can scarcely understand that it should require many years to discover these two simple facts.

The discovery that made long distance telegraphy possible is due to Professor Henry of the Albany Academy, afterward secretary of the Smithsonian Institution in Washington. Professor Henry was endeavoring to increase the strength of electro-magnets. Sturgeon had devised the horseshoe magnet with a single layer of wire, the iron core being first coated with wax, and the turns of wire not touching, for insulated wire was then unknown. Henry improved the magnet by insulating the wire and winding many turns of wire around the iron core. So successful was he that he produced a magnet weighing only 59½ pounds that would hold up a ton of iron. The great length of wire in the coils of this magnet meant, of course, increased resistance and weaker current, if no change had been made in the battery, but Henry found that what he called a "battery of intensity," that is, a battery of high voltage, would overcome the resistance of the long wire. These were the two things that were needed to prepare the way for the invention of a long distance telegraph, an electro-magnet of considerable strength even with a weak current flowing through its coils and a battery that would overcome the resistance of miles of wire. We should add another discovery, that of a battery that would give a constant current even with the circuit closed for hours. This we have in the cell devised by Professor Daniell of King's College, London, and in the gravity cell or crowfoot battery which is only a modified form of Daniell cell.

The materials for a successful telegraph were at hand when Morse took up the work. There was needed the practical man who should combine these materials and develop a working telegraph. That a man who up to the age of 40 had devoted his life to art, an artist, a dreamer, should become the practical inventor is one of the strange facts in the history of invention. When Samuel F. B. Morse first learned in a conversation on shipboard on his return from Europe in 1832 that an electric current will travel instantaneously through any known length of wire he had a vision of an electric telegraph girdling the earth. He felt that this was his work. He gave up his former vocation to a great extent. At times he faced starvation and in a little room provided for him by his brothers he gave himself up to working out his idea.

It was Morse's idea that the entire operation of sending and receiving a telegraph message must be automatic. He would not trust the human hand to manipulate the contact key nor the human brain to interpret the intervals denoting dots and dashes. He therefore made an automatic device for opening and closing the circuit at the desired intervals and an automatic recording instrument. The recording instrument was a pendulum carrying a pen at its lower end and a piece of soft iron opposite the poles of an electromagnet. When the current was sent through the coils of the magnet, the pen was drawn across a strip of paper. At first a weight and later a spring was used to pull the armature away from the magnet when the circuit was broken. If the armature was held against the magnet a very short time a dot was made, if for a longer time a dash. The instruments used in the first commercial work were smaller, the pen being carried by a short arm that was pulled away from the magnet by a spring when the current ceased to flow. It was the same cumbersome method of receiving the message, however, with the winding and unwinding of the tape, the whirr of wheels in the winding mechanism, the occasional breaking of the weight cord and the laborious reading and transcribing of the message on the tape.

Although the sound system was secured to Morse in his patent, for years the Morse company vigorously enforced rules against receiving messages by sound. When in 1848, James Leonard, the fastest operator in the country, discarded the tape system and received messages by sound, he became the wonder of the telegraphic world. The famous showman, P. T. Barnum, happened to place a message in the hands of Leonard. He was so surprised at his speed in sending and astonished at seeing him receive by sound that he offered Leonard a large salary to accompany his show and exhibit his skill in taking messages by sound. The offer was rejected.

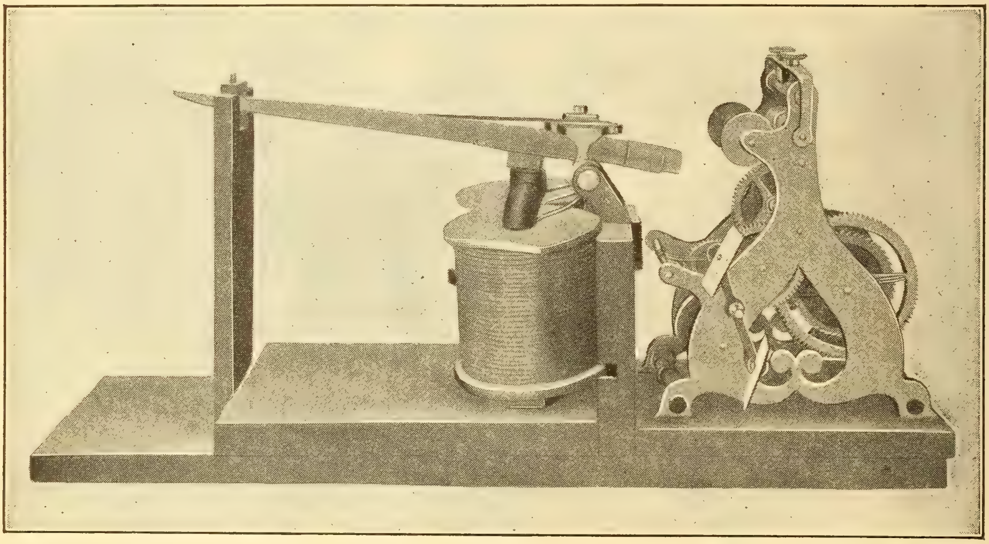
On the second of September, 1837, Morse gave the first public exhibition of his telegraph system, a message being sent through one-third of a mile of wire and recorded on the tape. In his first experiments Morse used an electro-magnet like the one employed by Sturgeon. He had not then learned Henry's device for increasing the strength of the magnet. The principle of Henry's magnet was given to Morse later by Mr. Vail, who became his partner. Without the assistance of Mr. Vail it is doubtful if Morse would have his telegraph a commercial success.

It was Mr. Vail who worked out the Morse alphabet. It occurred to him that the letters most frequently used should have the simplest signs. The problem of finding which letters are most frequently used had been already solved by the printers. So he chose the simplest signs for the letters that have the largest compartments in the typesetter's case. The most common letter of all, the letter "e," was represented by a single dot.

The Morse instrument was exhibited to the President and a Congressional Committee in the winter of 1837-8, and then began a long series of committee investigations and reports. Although the Committee on Commerce reported to Congress in April, 1838, that "the influence of this invention over the political, commercial, and social relations of the people of this widely extended country, will, in event of success, of itself amount to a revolution unsurpassed in moral grandeur by any discovery that has ever been made in the arts and sciences," it was not until 1844 that Congress could be induced to make an appropriation for establishing the first telegraph line.

It is significant that this Congressional Committee reported further that "the power of the invention, if successful, is so extensive for good and for evil, that the government alone should possess the right to control and regulate it."

An appropriation of thirty thousand dollars enabled Morse to establish a line between Washington and Baltimore, on May 27, 1844. The first message was sent over this line. This was the famous message, "What hath God wrought?" dictated by Miss Ellsworth. Morse had abandoned all hope of favorable action by Congress, had gone to his hotel, counted his money and found that he could pay his hotel bill and his fare home and have thirty-seven cents left, when Miss Ellsworth had brought him the news that Congress had made the appropriation for his telegraph. He promised her that the first message over the new line should be hers.



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THE MORSE INSTRUMENT USED IN RECEIVING THE FIRST COMMERCIAL MESSAGE, FROM A PHOTOGRAPH OF THE ORIGINAL IN THE U. S. PATENT OFFICE. THE ORIGINAL AS FIRST BUILT HAD A PIN ON THE END OF THE ARM WHICH TOUCHED A ROLL OF PAPER OPERATED BY THE CLOCKWORK MECHANISM

Morse made use of Steinheil's discovery that the earth could be used as part of the circuit. Steinheil had made this discovery in 1838 while trying some experiments on the use of the rails of a railroad as part of a telegraphic circuit. He found that the current would pass from one rail to the other through the earth, and the thought occurred to him that he might use the ground itself and dispense with half of the metallic circuit. This plan had the added advantage that it reduced the resistance of the circuit one-half, for the resistance of the earth is practically zero.

Vail tried the experiment of using an earth battery and found that a copper plate buried in the earth at Washington and a zinc plate buried at Baltimore and connected by a wire was sufficient to transmit a message, though it was found that the current was very weak.

Morse had contracted for lead pipe for the line from Washington to Baltimore, intending to place the insulated wire in the pipe underground. The use of poles was an after-thought. Copper wire was at first used, for it was known that copper would conduct the electric current better than iron. The first telegraph lines erected in the United States were of No. 16 copper wire insulated at the points of support by means of cloth saturated with gum-lac. The copper wires were too easily broken so they were soon replaced by iron wires of a larger diameter. The resistance of iron is about six times that of copper, therefore an iron wire to have the same conductivity must have six times the sectional area or 2¼ times the diameter of the copper wire. Such an iron wire has about twelve times the strength of the copper wire which it displaces while its cost is less.

Morse said that if he could make his telegraph work through ten miles of wire he could make it work around the world. Henry's method of winding an electro-magnet combined with the relay made this possible.

The relay was invented by Sir Humphrey Davy in England and afterward adopted by Morse. He was using a needle telegraph and, finding the current very much weakened when passed through a long wire, he thought that the slightest motion of the needle would be sufficient to bring into contact two metallic surfaces, and so close a circuit including a local battery. This second current might close the circuit of a third current and so on without limit.

Though Morse did not live to see the fulfillment of his prediction, a message was sent around the world in 1896. This message did not actually encircle the globe but it did travel across the two continents and the Atlantic Ocean and back to the starting point, a distance of 27,000 miles.

Making Iron of High Purity

Several decades ago the copper industry was partly revolutionized by the introduction of electrical methods, it being shown that an electrolytic process could not only produce copper at low cost from ores which had previously been neglected, but that the copper thus produced was of unusual purity. Now it looks as if similar methods when applied to certain iron ores may also prove commercial. Experiments just reported by Prof. C. F. Burgess (of the University of Wisconsin) show that iron can be deposited in thick layers by passing a current through a solution of sulphate of iron, at a total cost of about one cent per pound for the current, chemicals and labor. What is more, the iron thus obtained is remarkably pure, that obtained at Madison testing as high as 99.97 per cent, which purity might be still further improved by taking unusual precautions. It would therefore seem well suited for competing with the high grade Swedish iron which is at present imported at considerable expense, and the electrical production of such pure iron may mean another step towards making the United States independent of foreign markets.

Silver Plated Porcelain

If the richness of silverware could be combined with the lightness and the heat retaining qualities of porcelain, the combination ought to suit a quite fastidious taste without involving either the cost of heavy silver or the easy denting of lighter metal.

Besides being a poor conductor of heat, porcelain also conducts electricity so poorly that it cannot be covered with a film of metal in an electroplating bath unless the surface could first be coated with a conducting covering. Recent German efforts towards this seem to have been successful, for a line of such ware has recently been put on the European market as "Electro-Porcelain." This consists of tea sets, platters, sauce dishes, water jugs and the like made of china with an outer coating of silver, or in some cases, of nickel. As the interior is of porcelain, it will not stain even when used with eggs and is more easily kept clean than the solid metal ware. Hot foods in it will keep warm longer than in silver ware and the plated porcelain is said to withstand the jars of handling better than fine china.

The Blind at the Key

By H. METTIE

One rainy, November night, as the station agent at Park Junction closed the office safe with a slam, the door of the waiting room opened, and a spectacled man, with a cane in one hand and a nickel-bound black leather case in the other, entered. After a moment's pause, he set the case on a seat near the door and walked straight up to the window.

R.S.HAMBLETON.

"How about No. 4," he asked in a pleasant but eager tone.

"Why, hello, Mr. Wells," greeted the agent. "I didn't see you get off the train."

"No; I was in the country, about twelve miles below here, tuning some pianos, and one of my patrons brought me up in his buggy. I'm obliged to catch No. 4. We have to flag her, don't we?"

"Yes," answered the agent, and then he added, "There's a young woman here, too, waiting for that train."

Having completed his arrangements for the night and locked the office, the station official strode across the waiting-room to where the young woman sat.

"This blind man is going your way and knows all about the road and the trains," he explained. "I'll leave the lantern here for you to flag the train with," he added, as he placed it on a seat, "and I guess you'll have no trouble."

Above the lantern, in a socket on the wall, smoked and flickered a single lamp, which, as the agent opened and closed the door, flamed up and went out, leaving the lantern to do double duty." The girl shuddered. Half in pity, half in curious interest, her glance rested on the blind man who still leaned against the ticket shelf. She waited for him to speak. Finally, turning his sightless eyes upon her, he ventured:

"Miserable night."

"Indeed it is," she rejoined, "and such a dreary place to wait."

"Yes," he agreed, cheerful at the thought of her companionship, "but it might be worse." Then he took a turn or two about the room in order to get his bearings and relieve himself of the slight embarrassment he felt. "I've waited here a good many times," he added.

"It's my first experience," said the girl. "I missed connection with the accommodation, my train being an hour late, so I had choice between walking in the rain with the agent to a farm house a mile away or waiting. I confess I was dreadfully afraid, and it took all my courage to decide to wait; but"—she hesitated—"but since you are here it will not be so lonely."

"Thank you, " said the blind man. Then by way of introduction, "My name is Wells."

"And mine is Helen Duglace," she returned.

The man sat down beside his leather case, feeling for it as he did so.

"Can't you see at all?" inquired the girl, solemnly.

"Not a bit," he replied.

"Isn't it difficult for you to go about alone?" was her next question.

"Oh, no, not now. At first when I undertook to solicit business, I found it trying, but ten years of hustling have made it easier for me to get around, and now I find pleasure in traveling, coming in contact with people, studying them, and battling with the little obstacles we blind people have to encounter. Yes, I get along about as well as other people do, I presume. I have a good trade, and like my work." With his fingers he tapped nervously on the case beside him.

The girl peered into the darkness beyond the window and wondered how one who lived in constant gloom could smile and be cheerful. It was this thought which prompted her to say:

"Pardon me, but does it always appear dark to you?"

"Oh, no," he replied. "There can be no realization of darkness without light. It is only a matter of contrast, you know. I once saw, and, of course, I understand what you mean by dark. However, it has been so long since I saw the light that I seem not to be in the dark. When I feel the warm sunshine on my face, the world appears light. The knowledge that there is a lighted lantern there on the bench makes this room appear cheerful to me. Our mental world rotates between night and day almost in concert with the physical world. There is a softness about the atmosphere of a bright day which seems to throw light around me. Likewise the heaviness of a cloudy sky puts me into a semi-gloom. After all," he added, with a contented smile, "we live more in mind than elsewhere."

"Do you form pictures of people when you meet them?" asked the girl, with growing interest.

Wells leaned forward in an attitude of listening and did not at once reply. Suddenly he gave a little start and exclaimed:

"Great heavens! No. 4 is two hours late."

"Why, how do you know?" she asked.

"Just caught it over the wire. You see," he went on, "I used to study telegraphy a little, just for pastime, and it has served me well on several occasions. Station agents are so very economical with their knowledge that some of them find it hard to answer a civil question, so I frequently steal information about late trains."

"How remarkable!" said the girl.

"Not remarkable at all. I take the message just as they do. The operators do it by ear, and so do I. You asked me a moment ago if I formed pictures of the people I meet. Yes, especially of those who interest me. The voice is my strongest index of human nature. To me it is what the face, the eye, and the general expression are to you. It is the central feature that I remember as something that I liked or disliked. A voice lives in my memory as a face does in yours. Upon that foundation I build all other mental conceptions regarding those whom I care to study."

For some minutes there was a lull in the conversation. The water dripped monotonously in the spout, and the telegraph instrument ticked on industriously. Finally the girl spoke :

"Two hours late! That means nearly morning before the train comes."

"Yes," he answered slowly, as if his attention were divided between what she was saying and something outside. Presently he arose and moved toward her. ,'I fancied I could hear low voices outside, but it may have been the barking of dogs in the distance. The rain, the telegraph instrument, and the ripple of the creek below here make it difficult to distinguish sounds."

"It must be close to midnight," observed the girl.

Wells drew a watch from his pocket, touched the exposed hands and said:

"Eleven forty."

"Please, may I see your watch?" she asked.

"It is not much to see,"—he replied, extending the hand that held the timepiece—"only an ordinary watch without a crystal," and he proceeded to explain the simple method of telling the time by touch.

Suddenly the girl clutched his arm and whispered, "Listen!"

The wooden platform resounded to heavy footsteps, the waiting room door opened, and a man walked in.

"Which way's the agent?" came in a voice of peculiar smoothness.

"Gone home," answered Wells.

"You folks waiting for the express?" questioned the stranger.

"We are," Wells informed him.

"Well, I don't see as you need this lantern," said the man, as he picked it up, "I do, so I'll borrow it for a while," and with a swish of his gum coat and a rattle of the lantern, he departed as abruptly as he had entered.

Trembling in every fibre of her body, the girl clung to the blind man's arm.

"That fellow means mischief," whispered Wells, "I must see what he's up to." And he gently loosened her hold on his arm.

"Oh, please don't open the door," she entreated. "He has a revolver in his belt."

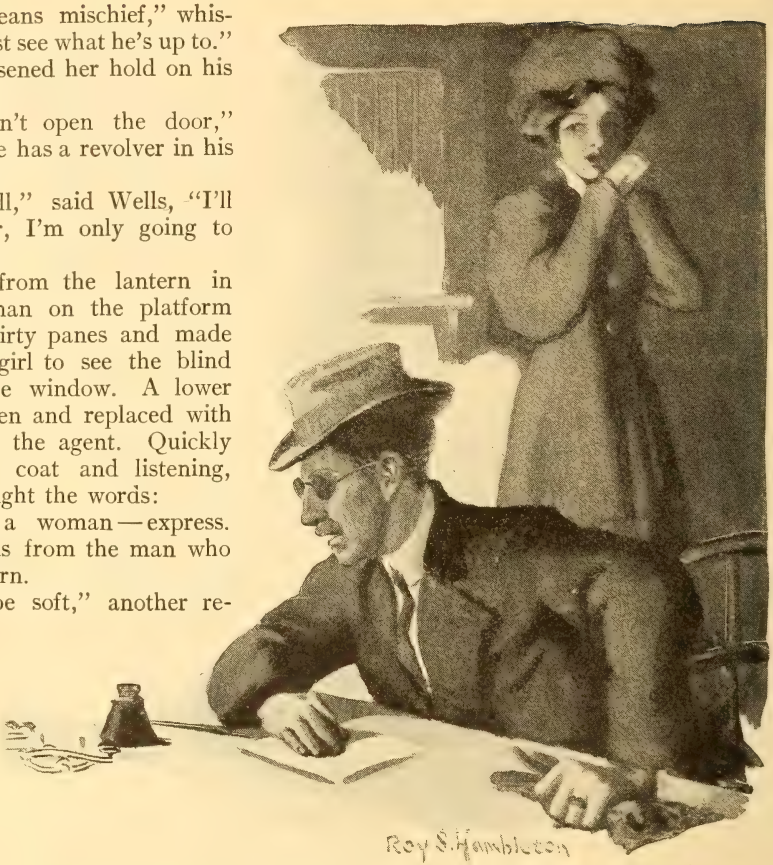
"Keep right still," said Wells, "I'll not open the door, I'm only going to listen."

A ray of light from the lantern in the hand of the man on the platform sifted through the dirty panes and made it possible for the girl to see the blind man crouch by the window. A lower glass had been broken and replaced with a discarded coat of the agent. Quickly pulling away the coat and listening, Wells' keen ear caught the words:

"A man and a woman—express. Agent home." This from the man who had taken the lantern.

"The cut will be soft," another remarked.

"Anyhow, it's an easy job," said a third.



DROPPING INTO THE CHAIR HE FELT FOR THE KEY

This was all Wells could hear, but it was enough to make him realize the situation. When the sound of their footsteps had died away in the distance, he straightened himself and returned to the side of the frightened girl who still stood trembling in the darkness in the middle of the room.

"Don't be alarmed, Miss Duglace," he said, "they're gone and we're safe. I'm sure, though, that they mean harm to the express—in fact," he emphasized, "I'd be willing to bet every dollar I possess that there's going to be a hold-up in the cut south of here tonight."

"What makes you think so?" she asked.

"In the first place," began Wells, "that man is a professional train robber. He was caught once, and served two years in the State penitentiary, but he made his escape. You see, the warden of the prison is a friend of mine. I have frequently been in his home, and was there once while this man—Adams is his name—was a prisoner, and I heard him talk. I could never forget that peculiar quality of smoothness in his voice."

"How did it happen, then, that he did not recognize you?"

"He might have, for all I know, but that wouldn't make any difference. He thinks I'm helpless. He'll see, though, whether I'm helpless or not."

"Oh, I wish we could do something." said the girl.

Wells was feeling for his tool case. "We can," he said as he opened it. "I'm going to bore out the lock of the office door and get into that telegraph instrument."

"I'll stir the fire and make a better light," said the girl, anxious to be of some assistance.

In spite of the serious business at hand, Wells laughed softly. "Never mind the light, sister, the less we have the better."

"Of course! I must be crazy," she said, as she trembled in the darkness.

"You stand close to the outside entrance," he commanded, "and warn me if you should hear anyone approaching."

The girl guarded the door and listened, while the blind man's sensitive fingers carefully traced the key-hole and latch. Soon he was boring, and his hands, long trained in the use of fine tools, made rapid progress. So excited was the girl as she watched and waited in the darkness that she could almost hear her own heart beat. The wind whistled dolefully through the telegraph wires; the dull drumming of the water in the spout kept time to the dreary dirge of night. The sightless man worked on. Once, thinking she heard the faraway moan of a locomotive whistle, the girl exclaimed:

"O mercy! Mr. Wells, I believe the train is coming!"

"It can't be," he replied, as his watch closed with a snap.

A few minutes later the girl heard a soft stroke of the little saw; a few more turns of the drill, and then Wells whispered,

"The lock—at last."

"Thank God," murmured the girl.

The office door went back with a creak.

Along the inner wall crept the girl until she stood leaning against the facing of the broken portal. Wells was already inside the small apartment. His hand touched each object that he encountered, first a chair,then the iron safe, and finally the operator's desk. Dropping into the chair, he felt about until his fingers found the key.

"Here we are," he said. "Let's see. I believe H.T. is Hartford's call. I'll try it," and he began ticking off the letters of the call.

There was no answer.

"I may be mistaken," he said to himself, "I'll just spell it in full a few times."

How his heart throbbed when the distant office rattled the answer in quick, sharp clicks. Then he sent an answer to the signal as fast as his lack of practice would admit:

"Hartford, for God's sake hold No. 4. Outlaws in the cut a mile south of Park Junction to hold her up."

"Wait," broke in Hartford,' "she is coming."

Trembling with suspense, Wells waited for three minutes. Again the instrument clicked.

"We have stopped No. 4. Who are you?"

As quickly as he could, the blind man sent his story over the wire, and back came the command from Hartford to "Stay at the key."

All this time Miss Duglace stood in the doorway, waiting breathless with excitement.

"We caught the express at Hartford," he informed her.

"Great!" she exclaimed.

Then came another message from Hartford "Have notified sheriff at Williamsfield, and gang will be surrounded. Wait at Junction for No. 4."

With a sigh of relief, the blind operator arose and made his way to where the girl stood.

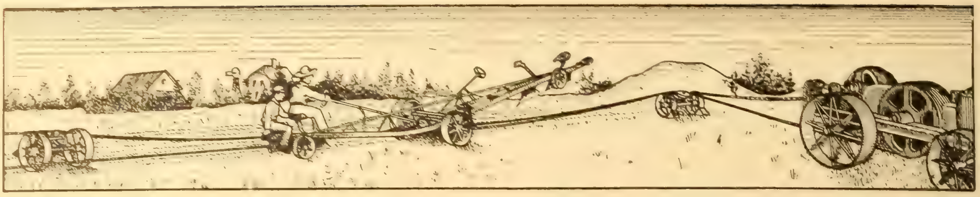
"You are perfectly wonderful, Mr. Wells," she said. She could not see the smile that illuminated his face, but she could feel the gentle pressure of his hand.

Lest one of the robbers might return to the station, and discover what had been done, Wells replaced the lock and closed the door. Then he revived the dying fire and he and the girl sat down to wait.

Just before daybreak the blast of a whistle brought them to their feet, and a minute later No. 4, with the captured robbers aboard, steamed up to the platform.

No telegraph operator ever received better pay for a night at the key, than that represented by the check which the railroad company sent to Frank Wells. It came to him in a letter while he was spending a week at the home of the Duglace family.

* * *



Electricity—The Farm Hand

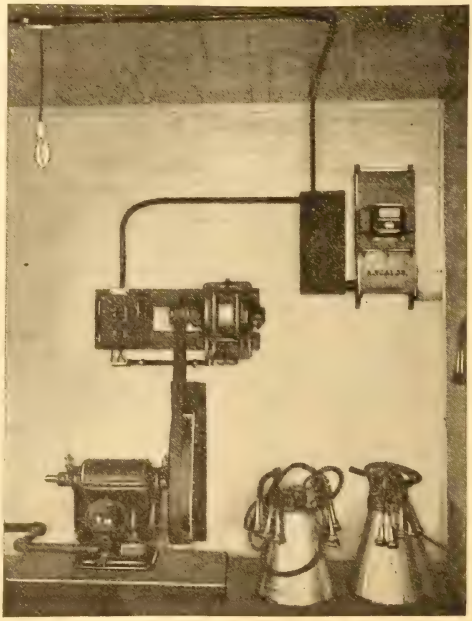
When the young men of ten years ago left the farm because of its hard labor and long hours, to seek employment in the large cities where shorter hours and more genteel labor is said to be found, they did not realize how close they were on the old homestead to a time when electricity would be the hired man.

The means afforded for obtaining electric current are increasing. Electric transmission lines from centrally located generating stations now run from town to town through many farm districts, furnishing power and light wherever wanted along the line. In other parts of the country the trolley or interurban line is used as a source of current supply, while on some farms are streams, which, when developed, are capable of furnishing water power sufficient to generate current for use on one or several farms. When one of these sources is not available a plant consisting of a direct connected gasoline or gas engine and generator set, and is so built as almost to take care of itself, may be had at a moderate cost, and with a storage battery affords an ever ready electric supply.

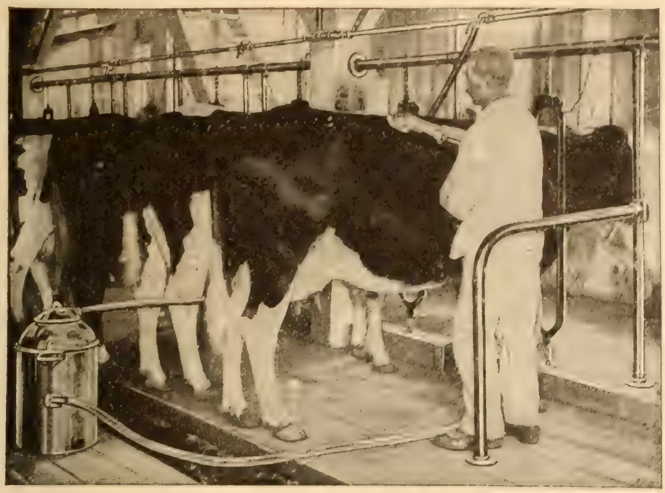
It is not the purpose of this article to take up the ways of generating or obtaining electric power, for, if the gas-engine method is decided upon, there are engine and battery manufacturers who stand ready to furnish plans and estimates for an equipment suitable for any particular set of conditions. Similarly with water powers, each of which represents a special problem to be worked out. If there is an electric central station or interurban railway company prepared to furnish current to a rural district, it also has its agents and representatives who are prepared to give the farmer engineering advice as to the methods to be employed in obtaining and distributing the current. But it is the purpose to show by illustration and a few descriptive paragraphs the ways in which electric power can now be applied to farming operations.

The city man who visits the modern farm will have more trouble to escape being called "green" than has his country cousin in seeing the city.

The tallow candle and oil lamp and lantern are disappearing from the clock shelf in the kitchen and a turn of the switch lights any part of the house, barn or other buildings, and furnishes current to a dozen different labor-saving devices in the home. In the heavy work in the barn, shop, dairy and field, however, electricity is at its best.



DAIRY VACUUM PUMP AND COW-MILKING MACHINE



COWS MADE SLEEK WITH A VACUUM CLEANER

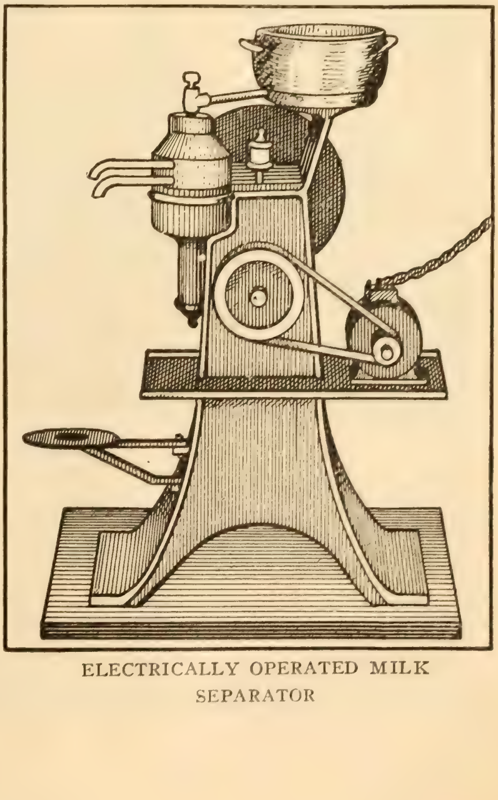
These things are said to be true on the modern farm, advisedly, of course, for it is not presumed that even a large minority of the farms of this country are as yet equipped with electrical conveniences. But the movement is growing, and each year the electrical manufacturers are developing new devices specially fitted for this work, and the electrical age is surely dawning for the farmer as it has already dawned for his city brother.

But to get down to specific examples: About the first thing we think of after the word "farm" is mentioned is "milking." Milking the cows by hand on a farm usually means getting up anywhere from four to five o'clock in the morning and is the after-supper job also. Electricity does this work in a quicker, more sanitary way. The outfit consists of a motor, suction pump, milk can and suction cups, these last on the end of a rubber tube. The can may be connected to a suction pump pipe outlet coming from the dairy, by a flexible rubber hose, the pump and motor being stationary in the dairy and utilized for other purposes. By making and breaking the vacuum in the tube suckers the milk is drawn and released into the can, giving no more discomfort to the cow than does her young calf in getting its breakfast.

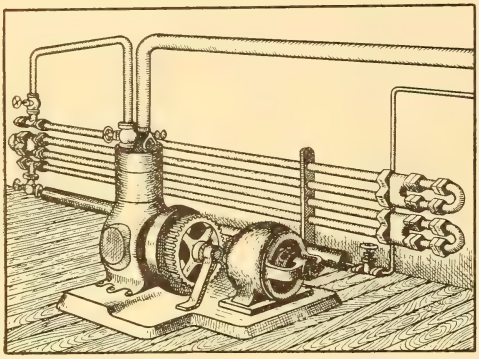
The dairy pump may be used also to operate a vacuum cleaner, with which, when the proper "tools" are connected, the coats of the horses and cattle may be cleaned after motor-driven rotary brushes have first "curried" and loosened the dust.

The dairy offers still more work for the motor, in operating the cream separator and driving the churn. We remember how mother used to work the butter in the old-fashioned wooden butter bowl, using a wooden paddle, but a motor-driven butter worker may now be made to displace paddle and bowl.

During the winter season in the country and after weather cold enough to form ice six inches or more thick on the lake or neighboring millpond, the farmers begin the "ice-harvest," helping one another to fill the several ice-houses which are often crudely built wooden affairs roofed over. The ice sawed into blocks is hauled to these houses and covered with sawdust, to be dug out the following summer. The use of ice thus gathered and stored is not altogether

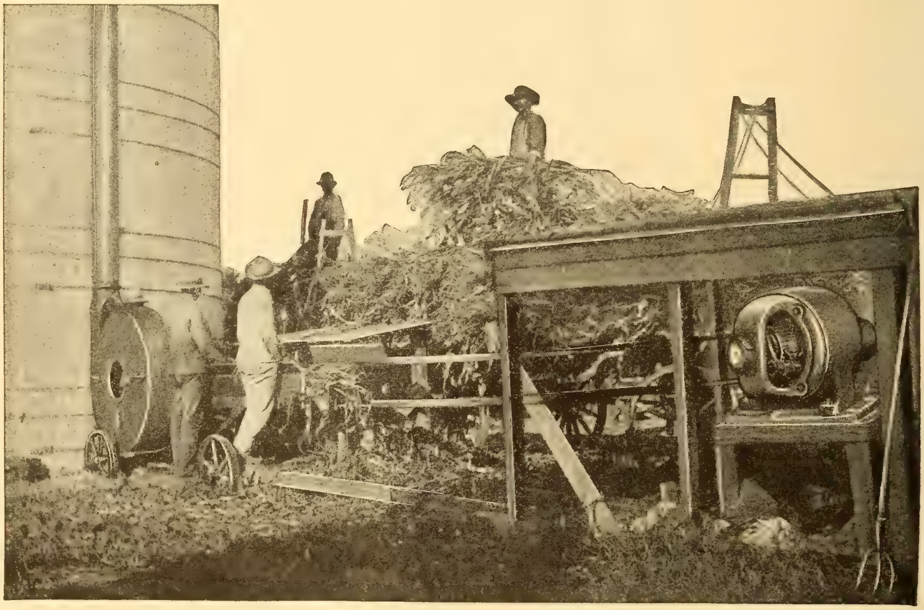


ELECTRICALLY OPERATED MILK SEPARATOR



ELECTRICALLY OPERATED REFRIGERATOR

satisfactory and involves considerable labor besides. There is always present a good deal of water, it is not possible to regulate the temperature at which a chill room may be kept, the ice is always wasting away and it may also contain impurities.

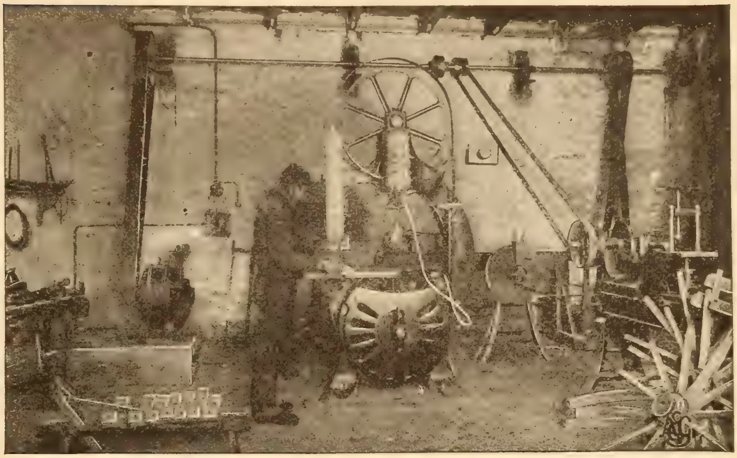


FILLING A SILO THE ELECTRIC WAY

Electric refrigeration does away with the ice-harvest even for the average farm by the use of motor-driven ice-machines which regulate themselves. Whenever the temperature rises or falls in the refrigerator the motor is automatically started or stopped, thus controlling by the pump, the circulation of the freezing fluid in the pipes. Outfits large and small are now on the market and the repeated trips to town for fresh meat during the hot weather of harvest and threshing time may be reduced to one or two, the cold dry storage of an electric refrigerator keeping a quarter of beef as long as desired.

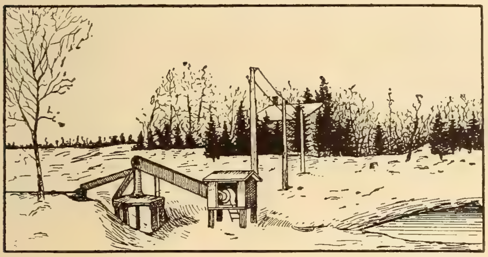
The modern farmer aims to utilize the full feed value of his corn and other fodder by cutting it up either by hand or horsepower and packing it in a silo. One of the illustrations shows the silo being filled the "electric way," a motor driving the fodder-cutting machine while a centrifugal fan blows the fodder up into the silo.

Nearly every farm has some sort of a shop where in bad weather odd jobs of repairing may be done on wagons, tools and farm implements. The shop shown is rigged up to run a lathe, a saw or any other needed machine from a single motor and jackshaft. Even the grindstone for the "love" of which many a youngster has lost out on an anticipated fishing trip, is here connected up, and future inventors, to compensate for past youthful drudgery, may yet produce an electric bait-digger. As but one machine out of several is usually operated at a time, a large motor is not necessary, and the cost of such an installation would not be excessive.



THE FARM WORKSHOP

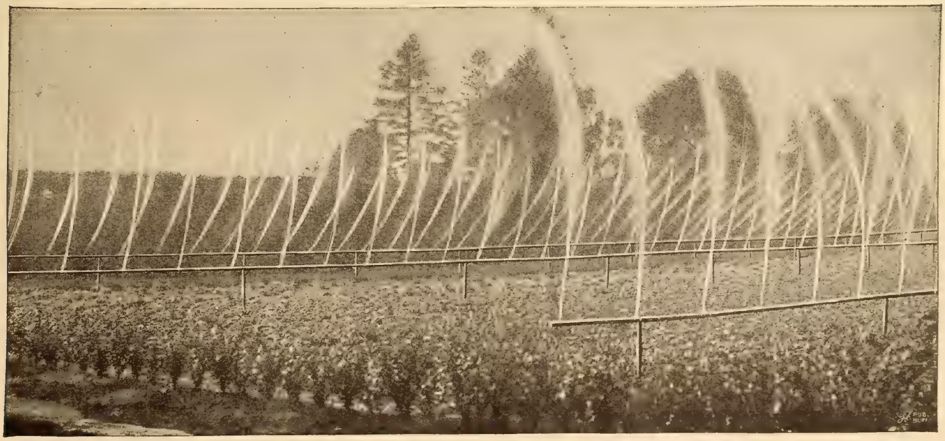
That patch of ground, and every farm has one, which seems to have no bottom to retain moisture after a rain or spell of wet weather is not a source of revenue. Then, too, there are the inevitable droughts that come at just the right time to endanger some crop. A small motor-driven pump set up under shelter as in the illustration is just the thing to use in draining and in modest systems of irrigating.



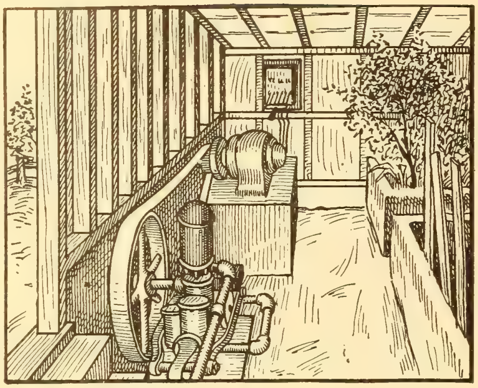
THAT LOW PATCH OF GROUND IS EASILY DRAINED

An interesting equipment in the form of a sprinkler system installed on a truck farm in New York State is here illustrated, pipes being run from the pump and on supports over the field. In some cases these pipes have been placed on supports high enough to allow the passage of a wagon under them. It is quite possible to arrange so that the water flow may be controlled from a distance as by the greenhouse electric pumping installation shown in one of the pictures on the next page.

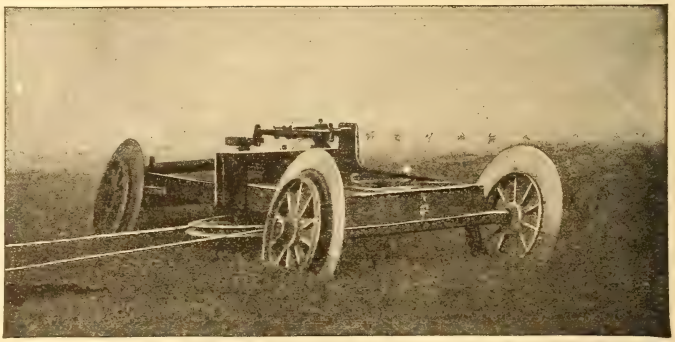
Following the plow handles behind a team of horses is still the most common way of turning the soil except on large farms, where steam plows are frequent. Europe, however, and particularly Germany, has at least a dozen motor-driven equipments and there is but small doubt that the electric plow will some day come close to performing its share of work.



SPRINKLER EQUIPMENT INSTALLED ON A TRUCK FARM



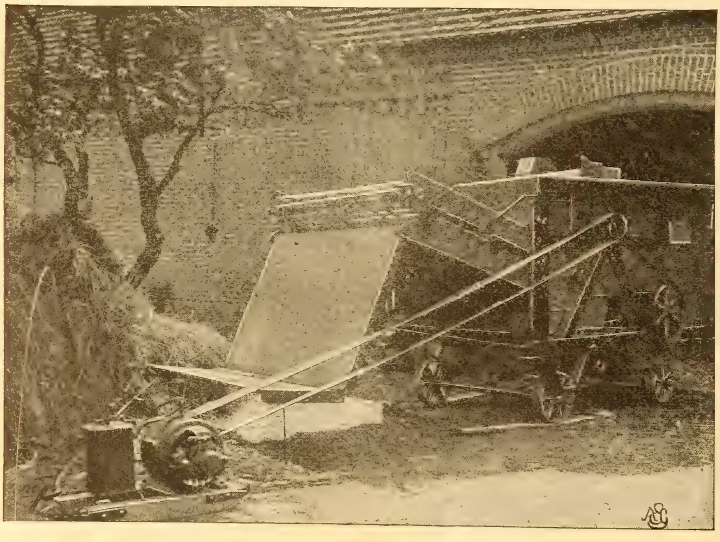
THE PUMPING OUTFIT IN A VACANT CORNER OF THE GREEN HOUSE



ANCHOR WAGON USED IN ELECTRICAL PLOWING

Edison predicts the extensive use of electric plows and rests this assurance upon the lightness, output and adaptability of his new storage battery, plowing thus being done with as simple an equipment as an electric automobile.

In the meantime, however, efforts in this line can only be called experimental and the day is still to come when electrically turned furrows will be practicable. Still, the pictures here shown of experimental equipments for electrical plowing are interesting as indicating one stage in the development so far attained. In this instance a jack carriage or truck carrying a motor and controller operates an endless cable and reel which, in connection with the anchor carriage and its flanged wheels on the opposite side of the field, drag the plow back and forth. One man at the jack carriage controls the motor, while a second looks after the plow. This is a queer looking implement arranged on the "teeter-board" principle with plows, steering gear and everything complete on each end of the beam, so by lowering one end or the other it will operate in either direction.



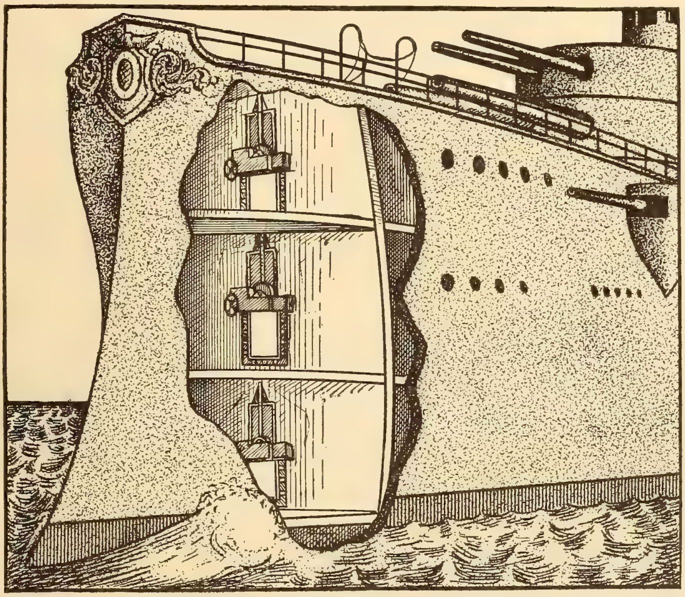
A PORTABLE MOTOR APPLIED TO THE THRESHING MACHINE

A motor which can be shifted from place to place, belted to a machine and readily connected by flexible conductor to a nearby outlet, finds unlimited uses on the farm. Such a one is illustrated in one of the pictures, being mounted, with its controller, on a sled. One horse can pull the sled and load to any location where it can be staked down ready for service, it being presumed, of course, that the premises are wired and provided with suitable outlets for attachment of the motor cable near such places as the motor will find employment.

Probably most practical farmers when they read this over will contend that all the devices enumerated above would cost a small fortune and represent an investment far out of proportion to the value of the farm. In answer to this it must be said that there are farms and farms. Some of the largest, where all operations are carried out on a big scale might well use all the labor-saving means described and get a commensurate return on the investment. On smaller places again, perhaps for the first beginning only electric lighting and the portable motor for all around work would be advisable. These are matters which each farmer must decide for himself after first having carefully calculated the cost of a certain installation and then set off against this the actual economies and conveniences to be obtained.

ELECTRICAL OPERATION OF BULKHEAD DOORS

As nearly everyone knows the hold of a modern ship is divided into compartments by water-tight partitions extending clear across the hull of the vessel, and having communicating doorways, which may be closed by water-tight sliding doors. Thus in case of accident permitting water to enter one compartmen through the hull of the vessel, the inflowing water may not enter an adjacent compartment. As a rule, lengthwise compartments are avoided, because filling one of them for very long might result in careening of the vessel and throwing one screw out of the water and even capsizing the ship. Or water might get to the furnace room and put out the fires.



WATER-TIGHT BULKHEADS IN A SHIP, SHOWING ELECTRICALLY OPERATED DOORS

So we may assume that the vessel may have from three to 20 water-tight compartments separated by cross partitions, having on several deck levels through-ways which may be closed at once in case of accident or danger.

The demands of the present day are for control of any or all of the water-tight doors from some central station, as well as the possibility of controlling any one of them not only from this point but also from other points convenient to reach. The principal thing is to render the closing independent of human working of the separate individual doors. It is rather difficult, if not impossible, to have the partitions free from doors under the water-line. That would result in an inconvenience to passengers which the most strenuous advocates of safety among them would be the first to resent. So all the various water-tight compartments are connected by doorways, the water-tight vertically sliding doors of which may be opened or closed from above the water-line; and the prompt and perfect action of which is tested daily not only at sea but also in port.

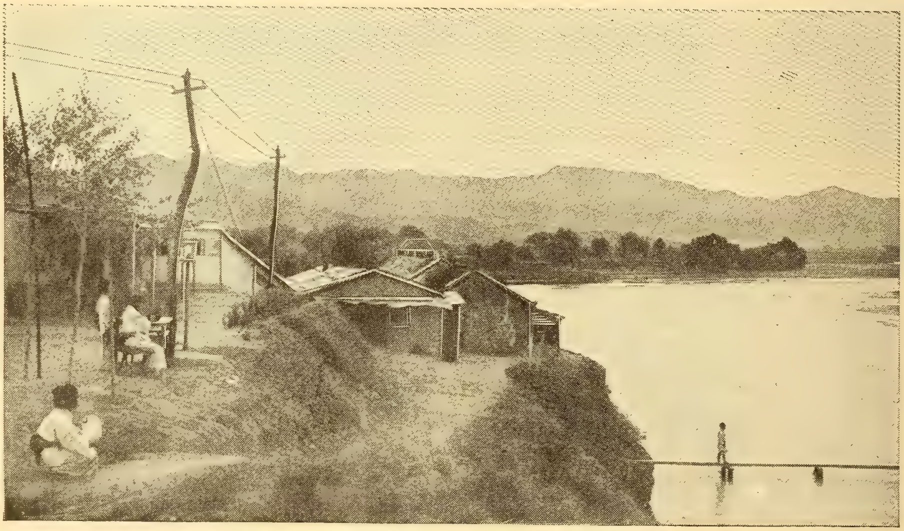
The doors are opened and closed either by hydraulic cylinders, receiving pressure from machinery driven by steam from the main boiler room, or by small electric motors through a worm and worm-wheel. In the latter system, which is the most modern and altogether the most efficient, there is an apparatus, located on the captain's bridge, which automatically connects the various separate motors with an electric circuit, so that the doors are closed in short order.

Besides the device for closing every door from the bridge, there is also a hand-closing apparatus for each one, independent of every other; a small hand lever throwing in the necessary motor for the door in question and opening it. As soon as this lever is let go, the door closes automatically.

Should there be any mechanical obstruction to the closing of the door—or anything in the doorway itself—the motor would be switched out at once automatically, but in such manner that the instant the obstacle is removed the door will be at once closed by the motor. Such a case might occur by reason of a leaky coal bunker.

The motor in question is a slow running compound which may be quite suddenly overloaded without injury. It is of about one horsepower, but for a short time may be crowded up to three horsepower. The door is furnished with a rack which is driven by a pinion in connection with a worm gear. The wedging action of the door itself is such that it closes tightly, but is readily opened without any great friction. There is force enough in the motor to cut through any ordinary mass of coal which might get in the doorway.

In connection with both the electric or the hydraulic system there is a widely-ramified system of alarm bells, to notify all who are below the water-line; and as a rule there is on the bridge a control system by which lamps show the officer there at once which doors are closed, and which are open.



The Telegraph in the Far East

The new Trans-Manchurian Railway, of which the papers have had so much to say lately, is drawing the attention of the traveler to the famous hot springs of Hsiung-yuehcheng, and it is some comfort to the sick, gone there for healing, to know that they are in telegraphic communication with home. The telegraph has penetrated the farthest East. How primitive it is the picture above, showing the telegraph poles, attests. Any old pole will do, whether bulging or not, and underneath these posts my Chinese lady sits, meditating to the whisper of the wires overhead.

Magnetic Dip

By BROTHER POTAMIAN, D. Sc., Lond. Professor of Physics in Manhattan College, New York

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The property of a magnetic needle by which it takes up a definite direction under the influence of the earth's magnetism was used for navigating purposes in European waters in the Thirteenth Century. The other property in virtue of which a needle, free to move in a vertical plane, will not remain in a horizontal position was not discovered until the Sixteenth Century, the fortunate discoverer being Robert Norman, a compass-maker of Limehouse, London. Norman described this peculiar behavior of the needle in his quaint little book The *Newe Attractive* which appeared in 1581, though the discovery itself was made five years earlier, in 1576.

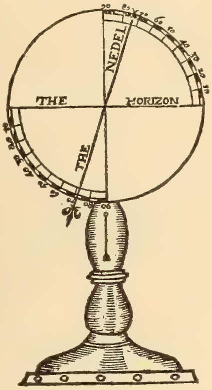


FIG. 1

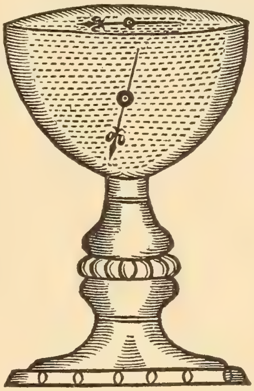


FIG. 2

Norman possessed many of the qualities of mind and hand that go to make up the successful investigator of the phenomena of nature; for he was cool, careful, painstaking and resourceful. In pivoting his ships' compasses, he noticed that however carefully he balanced them they did not remain strictly horizontal after magnetization, the north-seeking end invariably dipping downward to some extent. Knowing as he did that the act of magnetizing changed neither the weight of the needle nor its center of gravity, he rightly inferred that this unexpected action of the needle was due, in some way, to the magnetic influence of the earth itself. With the instinct of genius—and Norman was no ordinary man—he bethought him of swinging the needle on a horizontal axis instead of on a pivot so that the magnet might be free to move up and down in o vertical plane; and in this way, he was led to the discovery which is known today as "magnetic dip," a discovery of cardinal importance in the science of terrestrial magnetism.

Fig. 1 is copied from the *Newe Attractive* and shows that the dip in London was 71° 50′ when determined by Norman in the year 1576.

In Fig. 2, we have an apt illustration of magnetic dip devised by the ingenious artificer of Limehouse. Thrusting a steel needle through a piece of cork he pared the latter away until the needle floated horizontally at a certain depth. He next took out the needle and magnetized it. Replacing it very carefully so as not to disturb its position in the cork, he noticed not only that the needle sank to its former depth in the water but that it settled down in an oblique position at an angle of about 72 degrees.

The magnetic inclination at any place on land or on sea is determined by means of a carefully made dip-circle. Fig. 3 shows a laboratory model. After leveling the instrument, it is slowly turned around until the needle takes up a vertical position which it does when the plane of the circle stands at right angles to the magnetic meridian. The circle is next turned through 90 degrees in order to bring it into the meridian, after which the position of the needle is read at both the upper and the lower end for the purpose of eliminating any error that might arise from the center of suspension not coinciding with the center of graduation. The circle is next swung round through 180 degrees so that the side which faced east at first now faces west; the needle is read at both ends as before in order to eliminate this time any error that might arise from the non-coincidence of the magnetic axis of the needle with its geometric axis, or axis of figure. Finally, the needle is taken out of its bearings and its polarity reversed after which it is replaced in the instrument and two more readings taken to eliminate any error that might be due to the non-coincidence of the center of gravity and center of suspension. The mean of all these readings will give the true value of the angle of dip.

There are many places on the earth's surface at which the dip is zero; *i. e.*, where the needle remains exactly horizontal. Connect all these places together and you will have the magnetic equator of our planet; it will be found to be a wavy line encircling the globe and nowhere coinciding with the geographical equator, though lying near it. As the inclination of the needle is zero on the magnetic equator, this equator is technically called the *aclinic* line. If we connect together a number of places at which the dip has the same value, the joining line will be an *isolinic* line.

It is a fact of observation that as we ascend the ladder of latitudes from the equatorial to the arctic regions, the dip of the needle increases until, at a certain spot, it reaches its maximum value of 90 degrees. The needle then stands vertically over the interesting area which we call the magnetic pole of our Northern Hemisphere.

When the sextant tells the fortunate pole-hunter that his latitude is 90 degrees, he knows that he has reached the goal of geographical exploration; so, too, when Ross (Sir James Clark) on the first day of June 1831 found that the compass had lost all directive power and that the inclination of the dip-needle was 89° 59.5′, he concluded that he had finally reached the north magnetic pole of the earth. Swayed by a feeling of gratitude, he christened the newly-discovered land *Boothia Felix* in honor of Sir Felix Booth, the wealthy Englishman who financed the expedition.

Later on, in the year 1841, Ross, in command of the *Erebus*, undertook an expedition to the Southern Hemisphere during which he endeavored to locate the south magnetic pole. The greatest dip observed was 88° 35′, and this was in latitude 76° 20′ S, longitude 165° 32′ E.

It is germane to the subject to say that, after surmounting great difficulties and enduring untold hardships, Lieut. Shackleton's men finally located the south magnetic pole on Jan. 16th of the year 1909. They found it to be at latitude 72° 45′ S, longitude 145° E.

It is interesting to note in passing that Gauss, one of the greatest mathematicians of the Nineteenth Century, determined the position of the same pole from available magnetic data and found it to be in latitude 72° 35′ S, longitude 152° 30′ E.

Professor David and the other members of the party sent out by Lieut. Shackelton were grievously disappointed at not getting nearer the polar dip of 90° than their 89° 48′; and it was with manifest reluctance that they abandoned all further hunt for the antarctic spot of supreme magnetic interest, being compelled to do so by constant blizzards, icy winds, dangerous crevasses and failing provisions. It has now passed into history that the discovery of the two magnetic poles of the earth was made by officers of the British navy.

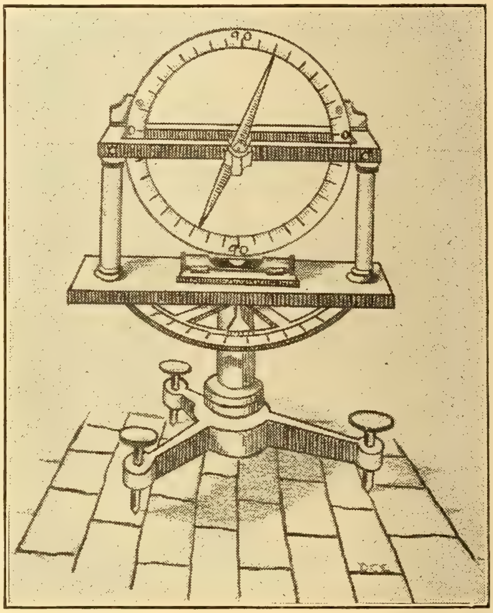


FIG. 3. LABORATORY MODEL OF A DIP CIRCLE AND NEEDLE

Observations on latitude have shown that the pole of rotation is not fixed and stationary as was universally believed until accurate observations of recent date disclosed its want of absolute steadiness, rhetorically called its "wobbling" propensities. These excursions of the end of our axis of rotation are, however, limited to a score of feet to the right and the left of the true polar point, whereas our magnetic pole indulges in secular wanderings of much greater amplitude, having shifted on a north-westerly course for a great many years at the rate of a mile and more per annum to return with the same impressive slowness to its original position in Boothia Felix. This we infer from the determinations of Ross in 1831 and those of subsequent arctic explorers including the observations of the Norwegian Captain, Roald Amundsen, in 1903-7.

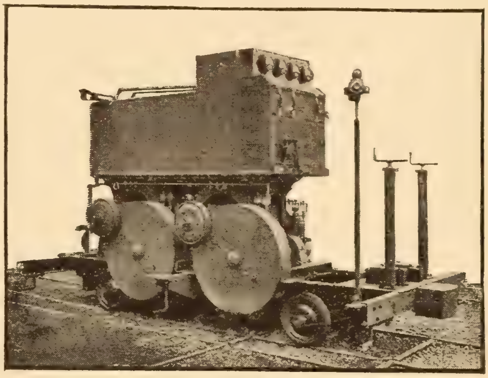
The dip of the needle is of no service to the traveler whether on land or on sea; but it is of primary importance in the science of terrestial magnetism as well as the physics of the globe. A study of the two elements—declination and dip—reveals the manner in which the earth's magnetism is distributed and enables us to realize the irregularity and complexity of this distribution.

Scenic Railway in Brazil

(Illustrated on the front cover, this issue)

According to the verdict of unbiased travelers few localities on the whole globe are equal in their charm to the bay of Rio de Janeiro, which has been a favorite theme for poets ever since its discovery 355 years ago. Sixteen miles long and nowhere over seven miles wide, its irregular shore line can easily be scanned from various vantage points on the picturesque hills which border it and particularly so from the Corcovado which rises to a height of nearly 2,200 feet above the bay and from which the capital city of Brazil draws most of its water supply. The view of the bay from different points on this mountain shows a continual variation of coast lines marked by a maze of inlets, of bird's-eye effects as to the city itself which stretches for nearly fifteen miles along the opposite shore, of clustered hilltops and of luxuriant tropical vegetation.

A single trip up this steep but scenic mountain will show even a skeptic why the difficult task of installing a railway reaching to the summit was warranted nearly 30 years ago. The road installed was a rack and pinion railroad operated by steam locomotives which too often belched out the smoke where it obscured the charming view. Now this road has been electrified, the power being supplied by a plant at Rio das Lages, fully 50 miles off. A 44,000 volt transmission circuit, arranged so that it can be increased to 88,000 volts if the demand for current grows, carries the current to substations where it is transformed into a safe voltage. Owing to the steep climb which ranges from grades of four per cent to some of 30 per cent, the rack and pinion feature of the old steam road has been maintained and a most unusual type of electric locomotive has been developed for this work by two Swiss concerns, the Oerlikon Maschinenfabrik and the locomotive works at Winterthur. This novel type of locomotive has a pair of 155-horsepower motors arranged so that they can serve as dynamos when going down hill so as to light the cars and furnish magnetic brake action on the downward trip while entirely disconnected from the twin trolley wires.



ELECTRIC RACK LOCOMOTIVE WITHOUT HOUSING

Bridge Wrecked by Electric Current

Recently a large wooden bridge stood over the Wabash River in Indiana. It was purchased by the county authorities to be replaced by a steel structure. The owners agreed to remove it in 30 days, which was a bigger task than was anticipated. They did not wish to destroy the piers or else it would have been blown up with dynamite. Neither did they wish to injure the masonry by burning the structure. Along came an electrician, then, who proposed to burn it apart with electricity.

Twenty-seven sills were to be cut in two simultaneously in each span and this was accomplished by burning them through with loops of iron resistance made red hot by the passage of electricity through the wires. The wires were arranged, the current turned on and in a few hours the last span had dropped into the river.

Invention by Effort and Study

By GEORGE ETHELBERT WALSH

Many of our great inventions appear to have been the result of accident rather than of well-directed and persistent effort, and there has grown up a pretty well defined impression that the inventor like the poet is born and not made. This theory has enough to justify it, in the lives of many of our great inventive geniuses, and we have records of inventions which seem to have sprung, without any previous thought or training, full-fledged and fully developed from minds gifted with unusual inventive faculties. But these accidental discoveries were in a great many instances the result of long study and work, and while the final achievement came suddenly and unexpectedly it was really the culmination of experiments and effort stretching over years.

In modern industrial life invention by accident receives less and less credit. The inventor of today is such by profession, and is equipped with experience and knowledge far more likely to aid in achieving results than the man without accurate training and study.

There is and always will be a certain element of luck, of accident, and of chance in invention, and there will be born men whose inventive faculties are much greater than those of the majority, but outside of a small number of well-known geniuses the greater bulk of our inventions come from unknown men and women toiling daily at their allotted tasks. Some of these are professional inventors who deliberately pursue this calling as a business, while others are working at various odd trades and industries but with an eye to the chances of possible self-improvement through the invention of some labor-saving machine or novelty. There are industrial organizations whose employees, no matter how humble and poor, are encouraged to make inventions, and if any one of them conceives a new idea he is given every opportunity to develop it. More than that, he is helped by experts, and if the idea proves feasible both credit and royalties are given.

In the last 50 years there have been over three and one-half million applications for patents, and over two and one-half million of these applications have been granted letters patent. A little less than one-half of these, or about one million, were granted in this country.

Sometimes we hear that the day of the inventor is past, and that the great fortunes realized on royalties will not be easily duplicated in the future. This conclusion is hardly warranted. The electrical field alone, although it has yielded vast fortunes to inventors, instead of being exhausted is now being diligently cultivated by companies which employ inventors on salaries, with a further promise of royalties on every successful achievement. Two of the greatest electrical manufacturing companies of the country have each an organized patent department, presided over by men of experience and ability. This board of inventors not only carries on a campaign of careful research, but it is on the lookout for all possible inventions from outside, as well as inside sources. Every employe is encouraged to make suggestions for improvements in his particular department, and if he has an idea of practical value it is developed for him. Some men appear to have the faculty of suggesting improvements, but not the ability to carry them out. Sometimes an ignorant workman can vaguely suggest how a thing ought to be done, but cannot tell exactly how. It is to develop such hazy ideas that boards of inventors are organized in many of our big industries.

Years ago when Niagara Falls was first harnessed, the theory of its organizers was that cheap electrical current would revolutionize lighting and rail transportation. But instead of achieving this result, the harnessing of Niagara gave as its first real benefit a stupendous impetus to invention. It was a great inspiration to inventive minds to have cheap electrical current furnished on a large scale and almost immediately experts began to delve deep down into the mysteries of electrochemistry to discover processes that could be developed and patented.

The Ampere Electrochemical Company was soon formed, consisting of inventors and electrical chemists, and it was more of a patent factory than a manufacturing enterprise. The aim was to discover and perfect new processes, and then turn the results of their efforts over to manufacturing companies to exploit. They were inventors and discoverers pure and simple, and they no longer found inspiration in their work when their goal was once reached. In this old patent factory were some remarkable and ambitious men; old inventors who understood all the ropes and guides to success; an old college professor who was familiar with all the theoretical knowledge of the age; the practical electrician; the business man; the trained chemist, and young, ambitious men with their laurels yet to win. No hint, no theory, no suggestion was too insignificant for these men to consider and follow out.

From this group of men devoted to invention came such money-making patented processes as the manufacture of carborundum, the making of nitric acid from nitrogen and oxygen, the production of a low grade of artificial camphor from turpentine, and the manufacture of barium salts and calcium carbide by an electrical process.

One of the greatest inventors of the age, Thomas A. Edison, has often been chosen as a typical illustration of the value of chance or accident in inventing. Yet Mr. Edison's whole life work is a contradiction of this theory. He is one of the hardest and most diligent workers of the age. He spent ten years of intense application to the perfecting of a single one of his inventions, and worked nearly as long on his electrical storage battery. In his own words, in an interview with the writer: "Invention is the hardest kind of work, and requires the intensest application of every faculty. There is nothing haphazard about it. There is no luck in it. You reach your goal by a process of elimination. Every factor must be studied, examined, and then eliminated if it is not what you want, until you have narrowed the whole problem down to two or three points. Then possibly luck or accident may play a minor part. Some day the whole thing will dawn upon the mind, and you see the goal you have been working for."

William Sturgeon invented the electromagnet, and in 1825 he presented to the English Society of Arts his first soft iron electromagnet, for which he was awarded a premium of $150 and a silver medal. His life was a perpetual struggle against poverty, and finally friends secured for him a grant of $1,000 and an annuity of $250. But he only lived a few months to enjoy them.

In more recent times many unpleasant stories could be told of inventors who were robbed of the rewards of their discoveries through failure on their part to protect themselves properly. Discovering some great labor saving device, they have sold their patent outright for a nominal sum or disposed of it to companies who simply "shelved" it for years without utilizing it. The expected royalties did not materialize and the inventors did not reap any profits as a result. This phase of the subject emphasizes the necessity of some business ability as well as inventive gifts. The Patent Department of the Government protects the inventor in the use of his discovery, but it can go no further.

One of the discouraging features of the whole inventing profession is that about one in every three applications must be refused because they infringe upon patents already granted. In the majority of cases the inventors are innocent of any intention of infringing upon the rights of others. They are simply poorly informed. Nearly every day applications for patents are made covering important parts of machinery which have already been protected by patents. In order to work intelligently one must make an exhaustive study of his specialty to see what others have done in this field. An idea new to one may be old to others. Before going to the expense of making models and applications study up on the subject and exhaust the field. It is this hard work and effort which brings success.

The profession of the inventor is one of the best and noblest of his day, and it benefits humanity as well as the individual inventor. But it is becoming more and more a specialized profession. Great minds, and many minds, are at work all the time in the field, and the amateur has little show in outstripping the professionals. The safest way is to make a specialty of one line and stick to it. There may be no reward for years, but if one is possessed of reasonable inventive faculties the results are bound to come. Often the greatest inventions waiting for some one to discover and develop them are lying very close by. It may be in some article of furniture, a tool which we use constantly in our daily work, or an article of dress which we handle every day of the year. It is well to cultivate the home field first and try to improve things with which we are the most familiar and not those of which we have only a vague knowledge.

Electric Block Signaling

By SIMON DEUTSCH, E. E.

PART V

The basic principle of the automatic block signal system, where the signal indications are controlled by the position of a train on the rails, condition of the track, switches, derails, etc., was founded on the track circuit. As has been previously explained, the presence or absence of the wheels of a train or car on the rails included in the track circuit, is indicated by its effect, electrically, on the electro-magnet controlling the signal circuits.

The signal indications are mostly conveyed by the semaphore signal, position indications being apparent to the engineer at daytime, and light indications at night. The semaphore signal generally consists of a blade, pivoted on a high post, and attached to a blade carrying a casting which has openings for glass plates or lenses of different colors, the blade when at right angles to the post, denoting "Danger" or "Stop." This combination of pivoted blade and casting is is operated through the medium of a rod connected to an operating mechanism similar to that shown in Fig. 17, the colored glass moving into a position corresponding to the position of the blade, and giving at night, a like indication.

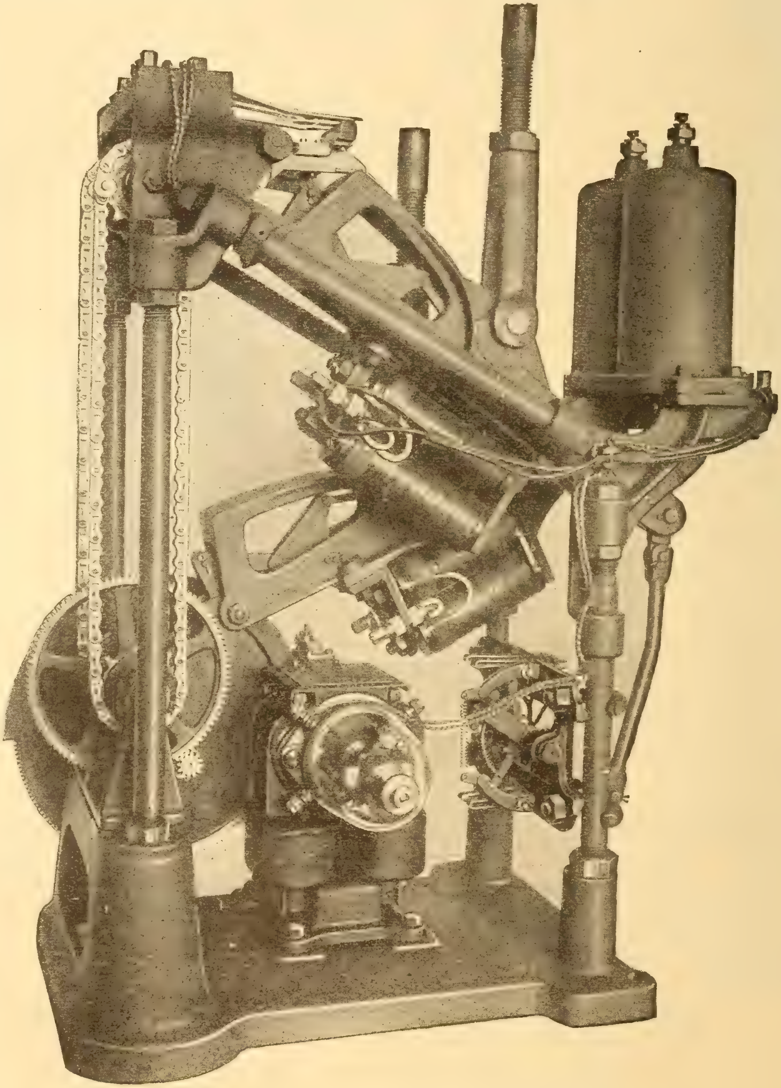


FIG. 17. MECHANISM WHICH OPERATES AN ELECTRIC SEMAPHORE

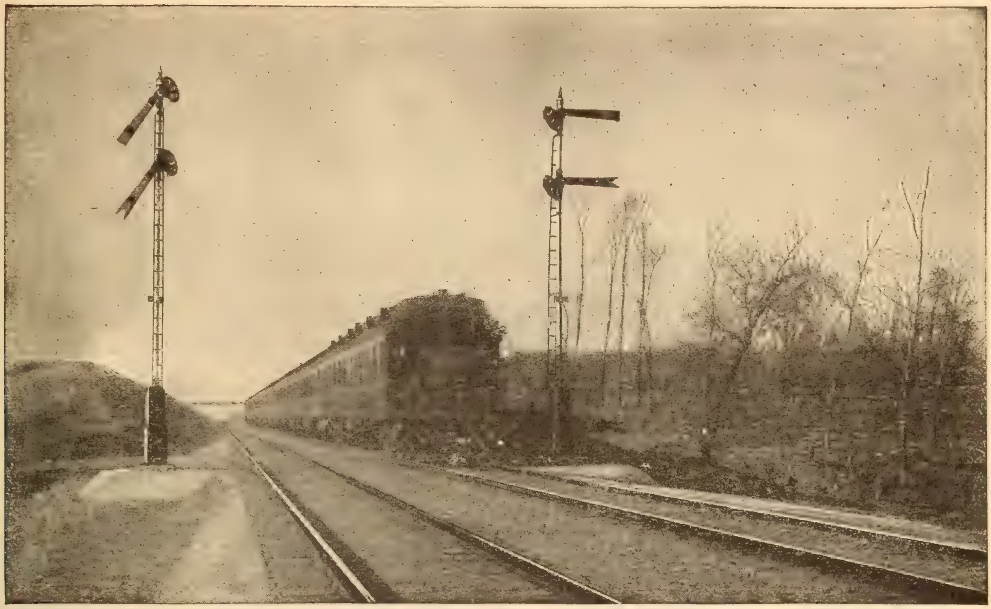


FIG. 18. THIS TRAIN HAS PROTECTED ITSELF—RIGHT-HAND SEMAPHORE INDICATES "STOP" TO FOLLOWING TRAINS

The means of operation shown by Fig. 17 consists of a motor driven gear and chain transmission, the chain being endless and interconnected at proper times to the blade operating rod through an electro-magnetically controlled arm, commonly called a slot arm. This slot arm, as will be noted, is permanently fastened to the blade operating rod, and carries with it a linked pawl which will engage with the operating mechanism,

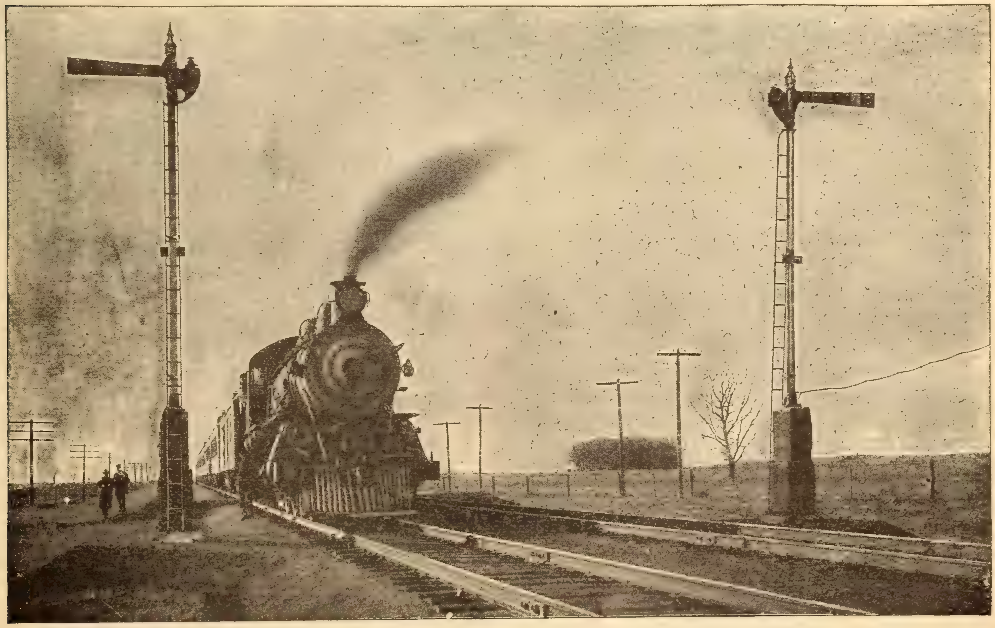


FIG. 19. LOS ANGELES LIMITED NEAR KEARNEY, NEBRASKA, OBEYING A "STOP"

only when the electro-magnet controlling this pawl, is energized.

Part of the current operating the motor is conducted into this electro-magnet, which generally consists of two windings, one of low and one of high resistance, by means of collector switches and flexible wires. As soon as track conditions are such as to cause the "track relay" to close the "signal circuit," the motor begins to operate and the linked pawl is simultaneously projected into path for engagement with the operating mechanism, due to the low winding of the controlling electro-magnet being in series with the motor. Thus the blade is carried from its original horizontal position, to a position corresponding with the indication which is to be given and at this point the motor circuit is automatically opened and the current switched into the high resistance winding of the electro-magnet, which uses but a small percentage of the original current, yet, is sufficient to hold the signal blade in the position to which it was carried. Inasmuch as the signal blade is in the "Clear" position the greatest part of the time, the function of the high resistance holding coil in reducing cost of power, is self-evident. Should any portion of this local signal circuit, or the "track circuit" to which this is secondary, be disturbed or deranged, current supply is immediately cut off from this slot arm "holding coil," and the linked pawl will be pushed from its path of engagement by the weight of the signal blade casting and rod, which are designed sufficiently heavy for this purpose.

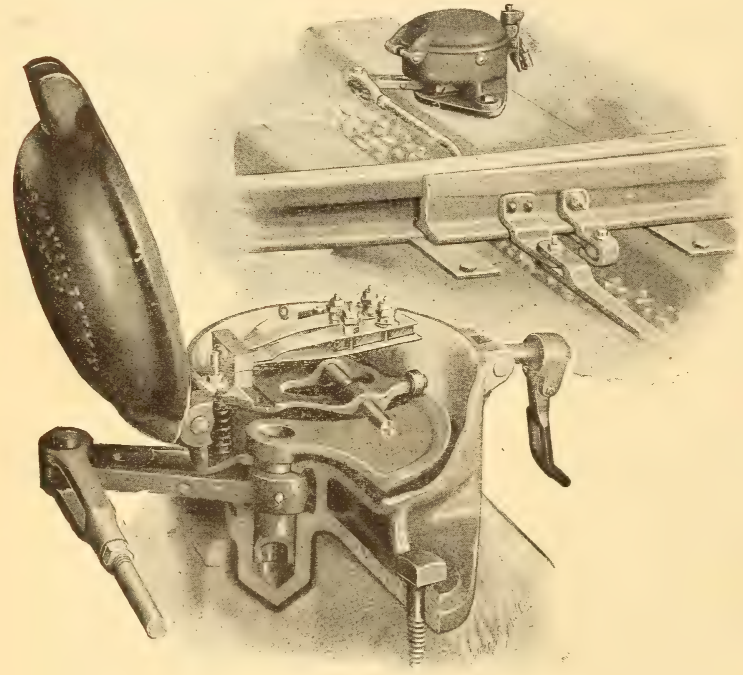


FIG. 20. MECHANICAL CONNECTIONS TO THE SWITCH POINTS

The operation of these signals in actual practice on the Union Pacific Railroad is clearly shown by Figs. 18 and 19. For protection against trains going into or coming from sidings, circuit controllers or "switch boxes," as they are commonly termed, are generally connected mechanically to the switch point, as shown by Fig. 20, so that a slight movement of the switch operates contacts in the switch box, which open or close the signal circuit. Normally all switches are set for main line trains, and the opening of a switch will set signals on both sides of the switch to "Stop."

In order that trains on a siding desiring to take the main line, may know whether or not other trains are approaching, a miniature signal, or switch indicator is placed at the switch stand, same being so connected electrically as to correspond with the position of the signals protecting that portion of the trackway within which the switch is located. In Fig. 21 is shown a common type of switch indicator.

Automatic block signals although primarily are thought of in the sense of protection, as a matter of fact hold an equally important position in increasing the ordinary traffic capacity over certain stretches of track. It is without doubt a fact that were it not for the possibilities of automatic block signaling, many of the railroads now satisfactorily operating single track, would under the same traffic conditions be forced to double-track their systems.

In general, the ideal arrangement of automatic block signals, for securing the maximum capacity for train movements over a given piece of track, is to make such spacing as will overlap the maximum distance required to stop any train on the road. This can be decided from air brake tests, and this distance would naturally be the maximum length of the block.

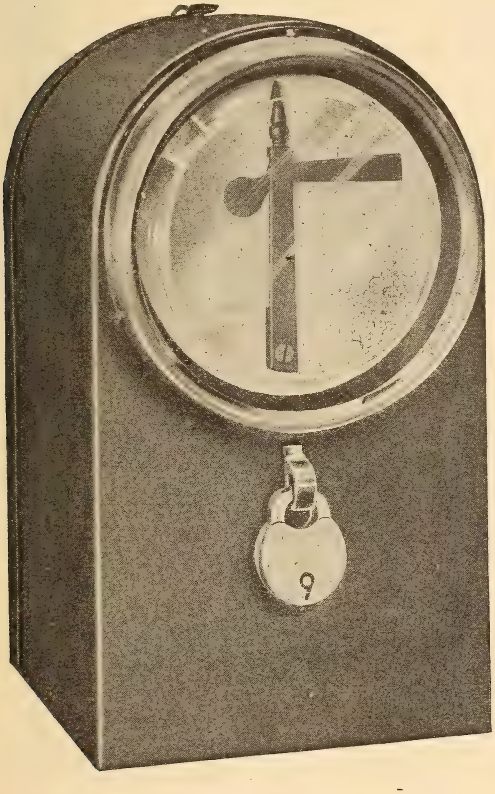


FIG. 21. SWITCH INDICATOR AT THE SWITCH STAND

Since it is more difficult to stop on a descending grade than on an ascending grade, the blocks would gradually be lengthened out on the descending grade, and gradually shortened on the ascending grade. As large terminals are approached, the blocks would gradually be shortened on account of the limited speed and congestion of traffic at such places. Having fixed the locations, the control of the signals should be such as not only to warn an engineer when he reaches a block which is occupied, but also to warn him in time to permit him to stop his train before reaching the entrance of the occupied block.

With this arrangement and control of signals, it would be possible to start two trains from one end of the line, two blocks apart, run them the entire length of the protected road at the same speed.

(To be Continued.)

A Telephone Repeater

Chicago talks every day by telephone with New York, and those who have given these accomplishments little attention often wonder why it is not possible to talk over still greater distances just as easily as we telegraph. The reason lies in the fact that the minute fluctuations in the talking current are damped out and lost if voltage and current of sufficient power to travel over longer stretches of wire be used.

"Why not have a repeater, as in the telegraph system?" is asked.

That is just where the rub comes in. A telephone repeater—for years the dream of inventors—is what is needed, but also, alas, what nobody has ever been able to make work on a commercial basis, unless the repeater of Charles Adams Randall, latest comer in this particular field of invention, should prove to be a practical business proposition.

Mr. Randall exhibited his telephone repeater at the recent Independent Telephone Convention in Chicago, and, although full particulars concerning its construction were not divulged, it apparently did the work over a dummy line equivalent to an actual line a thousand miles long. It has also been demonstrated on a series of short telephone lines in Iowa connected up to aggregate 4,460 miles.

The principle on which this repeater is based embodies the use of a special transmitter which will permit of the passage of heavier currents at higher voltage than ever before used for telephony, and that without any frying or sizzling and fusing of contacts. Furthermore, when a transmission is made, as far as is practicable a receiver at the distant end of the line talks into another of these high power transmitters and on your voice goes, from coast to coast if need be. This latter feature constitutes the repeater proper.

Correction

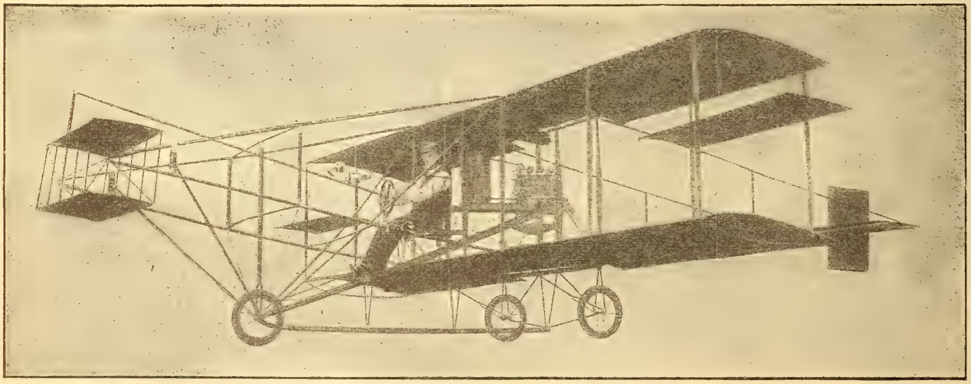
By one of those exasperating typographical errors which will sometimes occur in the printing of a magazine, it is made to appear in the March issue that Mr. Edward Schildhauer wrote his own biography under "Electrical Men of the Times." The biography was not written "by" Mr. Schildhauer. It was prepared in this office. Mr. Schildhauer is a modest man and it is a shame to have that one little word put him in an embarassing position.—Editor.

The Aero-meter

No legislative speed laws control the aeronaut's flight, nor are likely to; but other laws, old as Time, immutable as the Polar Star, he must observe, for the penalty of violation is Death. Can inventive genius supply this need and reduce the dizzy pace to miles per hour?

The lifting and supporting power of the planes depends on the speed at which they are driven through the air; and all evolutions depend on the supporting power. It therefore becomes of the utmost importance to the aeronaut to know at what speed he is moving through the air. A breeze may be retarding him, so far as the earth is concerned, or it may be blowing him onward; but his flight, his ability to sustain his weight and that of his machine, is governed by his speed through the air that carries him, and by nothing else. It would not help him to observe speed indications based on his movement over the earth. He must measure his speed with reference to the air that carries him.

As a consequence we now have the aerometer, one of the first aeroplane "accessories," its inventor being Mr. A. P. Warner of Beloit, Wis. On the front of the aeroplane are mounted four little cup-shaped devices on the ends of two arms placed at right angles to each other. These are similar to the ordinary wind velocity indicator. These rapidly revolving arms turn a very small dynamo which generates electric current. The faster the arms rotate the higher the voltage or electrical pressure developed. In fact the voltage is exactly proportional to the speed, so that it is possible to measure this voltage on a little meter right in front of the aviator's eyes and have the face of this meter calibrated to read in miles per hour instead of volts.



AEROPLANE EQUIPPED WITH AERO-METER

An Electric Sandwich Man

A retailer who believes in advertising through the medium of "sandwich men" recently employed one to walk the sidewalks after dark each night in the neighborhood of the store. The man was decked out in evening dress, with silk hat and open shirt front. Upon the bosom of the laundered shirt the trade-mark and name of some article on sale at the store that employed the walker was formed by small battery lamps—a miniature electric sign. The man flashed the lights at intervals and when persons about him least expected it. In time the walker became known by the name which he flashed across his shirt front. A battery secreted in his clothes and a push button to press completes the outfit.

Ripening Bananas by Electric Heat

Among the many uses to which electricity is put there is none more novel than that of ripening bananas. A dry heat is necessary because of the steam arising from the sweat of the fruit during the ripening process. Also, a temperature of about 75° F. must be maintained in the room at all times. These conditions are best maintained by placing a small electric radiator in the room.

Courtesy of "Chained Lightning"

RIPENING BANANAS ELECTRICALLY

Getting a Ship's Location During Fogs

When a vessel is near enough to land so that it can receive ordinary sound signals sent out from some point on the shore, these will be much longer in reaching the ship than a wireless message sent out at the same time from the same place. In fact, the time consumed in transit by the wireless signal will be too small to be measured by ordinary methods, since the wireless wave travels at the rate of over 186,000 miles per second. For any distance within hearing, such as five or ten miles, this time interval will be negligible so that we can assume that the message is received on board the vessel at the same instant that it is sent from the shore.

But if an audible signal (like the firing of a gun or the tapping of a gong) is sent at the same moment, this will travel through the air at the rate of only 1,123 feet per second, assuming the temperature to be at about the usual average of 60° F. Therefore if both signals are sent simultaneously and the mariner notes the difference in time of their receipt, multiplying this by 1,123 will give the distance in feet between him and the source of the signals. Then since there are 6,080 feet in a nautical mile, there will be 11,230 divided by 6080 or 1.85 sea miles for every ten seconds of intervening time.

Knowing this, the mariner who is groping round in the fog somewhere near land can call the nearest wireless station and ask the operator to tell him its location and to send out simultaneous sound and wireless signals, from which he can easily figure his distance from this wireless station.

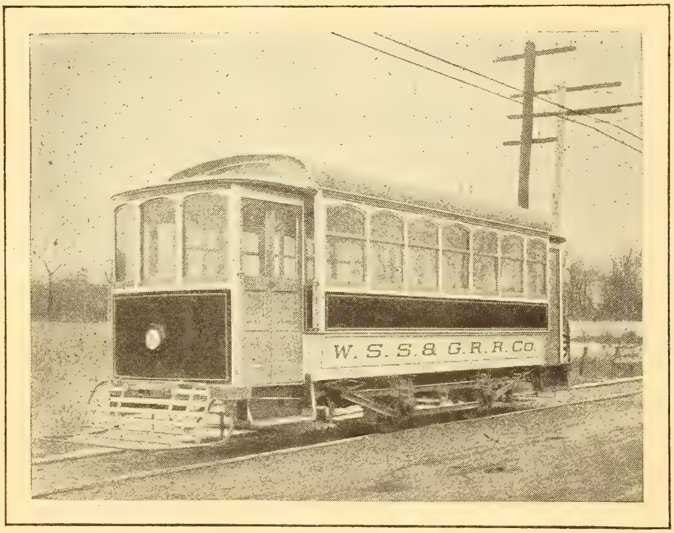
Suppose the interval between receiving the wireless message and hearing the sound to be 27 seconds, that would mean a distance of just five miles, hence he will know that his vessel is somewhere on the outer edge of a circle drawn on his map about the location of the wireless station with a radius of five miles. Now suppose the vessel travels in a fixed direction (as shown by its compass) for say four miles (as shown by its log) before getting another pair of signals which show that it is now seven miles from the same point on the shore. Then if the pilot were to cut out a triangle having 5, 4 and 7 mile sides to correspond to the scale of his map, laying this triangle on the map so that the four-mile side is in the direction just traveled by his ship while the opposite point is at the wireless station, the end of the four-mile side will show the present location of his vessel.

To avoid the cutting out of paper triangles, Capt. W. J. Smith of the Seattle Nautical School has invented a folding rule with a third part sliding on one of the two jointed ones. By using this rule on his chart he can find his location in the above manner almost instantly.

If the simultaneous wireless and audible signals were sent out regularly say every half hour during fogs by certain stations, the mariner would not even need to call for such signals, but could always get his bearings in this way when near enough to the shore to catch the sound waves. Hence Capt. Smith predicts that in the near future such an issuing of simultaneous signals at stated intervals during foggy weather will become a regular practice as an aid to navigation.

Can the Battery Car "Come Back?"

Among the very first attempts at electric railroading the experiment was tried of operating cars by means of storage batteries. This scheme was abandoned at a very early stage in the development and the overhead trolley and the third rail were considered to be the only practicable methods of supplying power to a car. In those days storage batteries were too inefficient and would not "stand the racket." There is a tendency, however, in almost all lines of development to revert, at some time or other, to earlier types. The question now is: Can the storage battery car "come back?" Since the new Edison battery has been perfected and tried out on a working basis for the operation of street cars many are inclined to think it can.



CAR OPERATED BY STORAGE BATTERY

Some mention has already been made in these pages of the new "Beach Car," as it is called after its designer, Ralph Beach, which has for some time been operated on two of the crosstown lines in New York City. These cars are equipped with Edison batteries and possess certain economical advantages which may lead to an extensive adoption. Just now the most interesting equipment of this sort is being operated in Washington, D. C., by the Wash. Spa. Spr. and Gretta Railroad. Aside from the fact that this line, now a trolley line, will have its wires taken down altogether, the point of greatest interest is that this road, four miles in length, consists entirely of grades, with the exception of about 800 feet, the length of two sidings which are at level. The grades range from one per cent to eight per cent, and some of them are very long. The car is said to operate over the Washington grades beautifully. It makes the schedule speed of four miles in fifteen minutes, which includes all stops, and which is barely possible to maintain with trolley cars.

The Beach car is able to take full advantage of its coasting qualities. Once it reaches the peak of a long grade, the men "turn it loose," and with its chain gear, roller bearings, and independent wheel action it coasts down the hills faster even than automobiles alongside on the country turnpike. The ordinary trolley car cannot be allowed to coast very much because of the inadequate spring arrangement—at an unusual speed it occilates at the first rail joint, and the brakes have to be applied constantly—whereas the battery car does not "rock at all," even crossing switch frogs.

This coasting feature and the small savings here and there in the weight of the car, the independent wheel action, in the gearing, etc., altogether result in a very considerable saving in power per car mile, according to tests which have been made.

What effect the Beach car may have in the ultimate elimination of the overhead trolley, which, after all, does seem somewhat unsightly and cumbersome, it is impossible at this time to foretell. But undoubtedly it is doing its full share of the "pioneer work."

Trackless Snow Plows and Trucks

Encouraged by the success of the trackless omnibuses in Italy, Austria, Switzerland and California, several manufacturers have been experimenting with trolleyed vehicles for other than passenger purposes. In Austria the Daimler Motor Society has lately been using trackless trolleys for heavy hauling, two of its new types being shown in the illustrations. One of these is a hooded truck with a carrying capacity of four tons, the vehicle itself weighing about half as much.

The other is a trackless snow plow which has a big advantage over the usual plows of the traction companies in that it can be shifted from one part of the road to the other. The plow as shown has a wagon box for hauling the snow and proves surprisingly effective.

TRACKLESS TROLLEY TRUCK

Three men with this trolleyed plow were able to remove as much snow in one day as six men with two teams formerly moved in two whole days.

Telephone in the South Pole Quest

A telephone system is to be installed at the south pole, or as near to it as explorers can get. Captain Scott, who recently started on a search for the earth's lower extremity, took with him a complete telephone equipment, consisting of five sending and receiving instruments, a number of light poles and six drums, each containing thirteen miles of aluminum insulated wire. The drums are so made that they can be attached to the rear of a sleigh and the wire laid on the snow as fast as the sleigh moves forward.

TRACKLESS TROLLEY SNOW PLOW

Uninsulated wire was selected because of its lightness. It is believed that the extreme dryness of the atmosphere will make insulated wire unnecessary, and the increased conductivity due to the extremely low temperature will more than compensate for any leakage of current.

The telephoner receivers and transmitters are made of wood because it is feared that ebonite would crack under the effects of the extreme cold.

It is planned to run several lines from a central station, one to an observatory a mile away, another to a post in the open air five miles distant and another to the explorer's headquarters 26 miles distant from the central station.

This telephone system will be of great assistance in enabling simultaneous photographs to be taken.

Sunday Telephone Letters

Not to be outdone by the American system of lettergrams under which a telegraph message sent at night is mailed by the operator at the receiving station so as to reach the addressee in the morning mail, the English are introducing a novelty in the form of Sunday telephone letters. Here the idea is to get the message to the person addressed without the need of carriers such as the special delivery messengers to which we resort in this country when we want letters delivered on Sunday. The Englishman writes on his envelope: "To be telephoned on Sunday," and adds an extra half cent of postage for every 30 words or fraction thereof. Then the postal clerk at the receiving office calls up the person addressed by telephone and conveys the message without leaving the post office. If enough postage is included, the same message may be delivered by telephone to a number of different parties in the same city.

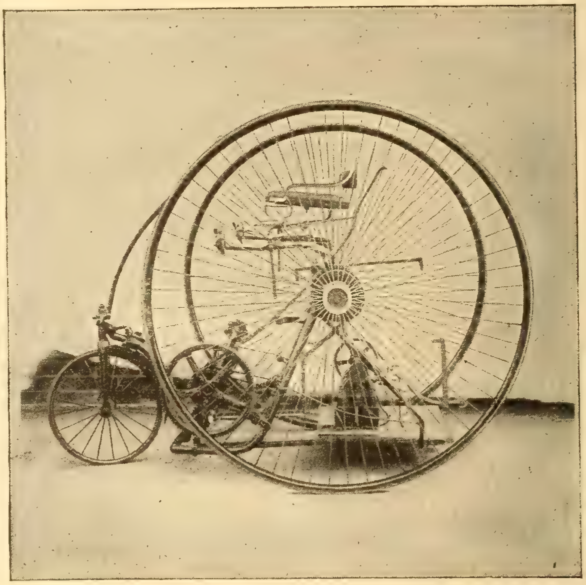
Odd Electric Vehicle—'89 Model

In the September, 1910, issue of Popular Electricity there was presented a picture of the first electric automobile. That is, it was the first electric road vehicle approaching the lines of present-day construction. If we include under this category any kind of vehicle for road work driven by batteries the odd machine shown herewith antedates the one above mentioned by two years. The machine is best described in a letter from Mr. Fred M. Kimball of Boston to Mr. Day Baker, manager of the New England office of the General Vehicle Company. To quote from this letter:

"Agreeable to your request, I hand you herewith negative of the tricycle to which my firm, Fred M. Kimball & Co., adapted the electric drive for Mr. P. W. Pratt of this city about the year 1889.

"The switches on the extended arms in front of the seat were used, respectively, for ringing an alarm bell and governing the supply of current furnished the motor.

"The motor, as you will observe, was a two-pole, back-geared machine and transmitted its power to the foot pedal shaft by means of a sprocket pinion, gear and sprocket chain. From the foot pedal shaft, power was transmitted to the driving wheels by another sprocket chain.



QUEER ELECTRIC VEHICLE OF '89

"The vehicle was equipped with six cells of storage battery, and the crate in which the batteries were assembled was supported by spiral springs from the crane arms, seen projecting fore and aft, respectively, just above the axle. A mechanical band brake, the operating lever of which is seen rising just behind the seat, was an important factor of the outfit, which weighed, all together and ready to operate, about 300 pounds.

"The flexible leads which connected the motor to the battery can be seen coiled up through the spokes of one of the driving wheels. They are identified by one U-shaped terminal, which is plainly discernible.

"This machine was first tested in Winthrop Square, Boston, just after the first concrete pavement was laid therein; subsequently, it was run for several weeks on Columbus Avenue, which, at that time, had just been repaved with concrete."

"The original owner, Mr. Pratt, used the machine two or three years in Boston after which it was taken to Atlantic City and was one of the attractions of the Board Walk.

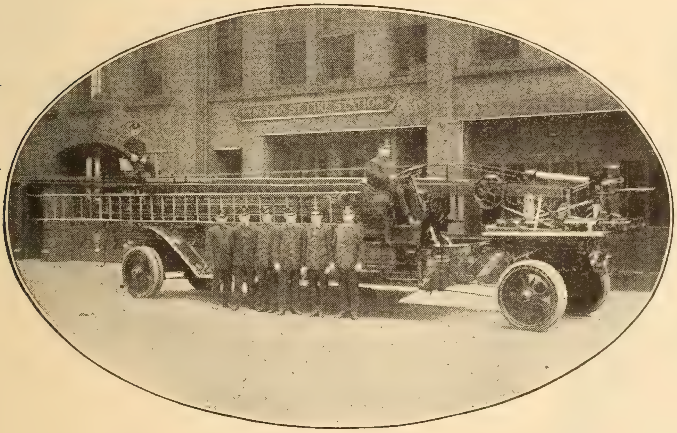
Tungsten Production in 1910

According to the *Electrical World* the production during 1910 of 1,824 short tons of tungsten concentrates is believed to be the largest annual output made by this or any other country up to date, although the total value of the product falls below the figure of 1907. The value of last year's output was $832,992, while that of three years ago was $890,048.

Nearly all the tungsten is produced from fields in Colorado and California, and in the former state the Boulder field, which is the greatest producer, is situated. The second largest field is the Atolia field in California. Arizona, Washington and Nevada also contribute to the output.

A Hook and Ladder Electric

The first electric hook and ladder truck ever built has just been turned over to the Springfield, Mass., fire department. Like the electric fire engine and hose reel the electric motors propelling the truck are located in the wheels themselves and the armatures turn as one unit with the wheel hubs.



A HOOK AND LADDER ELECTRIC

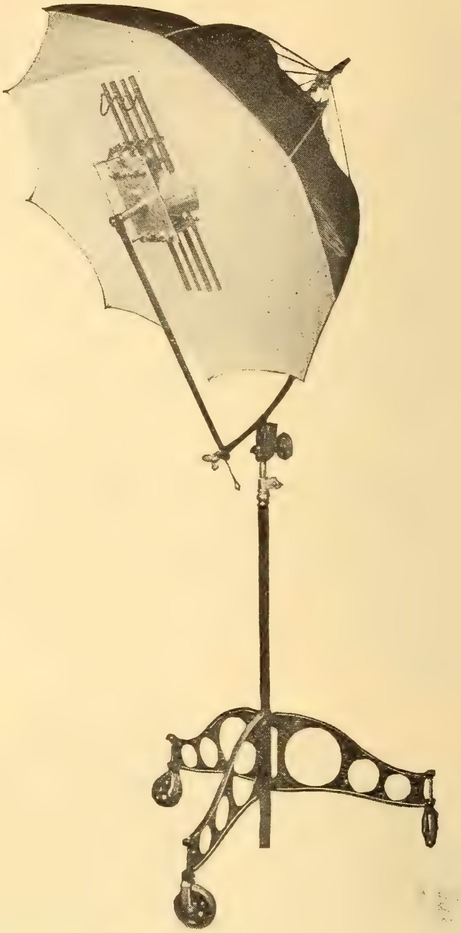
The building of such a long, ungainly vehicle was somewhat of a problem and the vehicle as a whole was the product of no less than four firms. The battery being made by one firm, the trucks and running gear by another, the wheels by a third and the body by a fourth.

The four motors located in the wheels impart a maximum speed of 20 miles an hour, and 80 cells of the new Edison batteries are utilized to furnish power. An automatic arrangement in the engine house provides for the charging of the batteries at all times that the hook and ladder is in the house, thus the batteries are always fully charged and ready for use. An electric search light provides light at night and plenty of it, giving about twice as much light as two ordinary automobile headlights combined.

Pocket Lamps at the Opera

The average play-goer glances over his program before the curtain rises and remembers the names of the actors well enough so that he does not need light at his seat while the curtain is up. But with music lovers it is often different, for the true connoisseur likes to bring his score with him and to watch it during the course of the concert or opera. Then the serious problem arises: Shall the house be darkened sufficiently to make the stage stand out by its brilliancy, or shall there still be light enough so that patrons of the opera can read their librettos or scores?

That this is still a live question, was shown by some discussions overheard during the recent Grand Opera season at Chicago, where some advocated a moderate illumination of the auditorium all through the evening, with a correspondingly more intense lighting of the stage. Others suggested that as the light for reading librettos and music scores was only needed at the listener's lap, this should be supplied by a miniature lamp fastened to the seat in front of him and placed too low to shine into the eyes of anyone. While this hardly seems practical, it recalls the experience of the Convent Garden Opera House in London some years ago during the Wagner festivals. There so many of the regular attendants brought pocket electric lamps with them that the scattered flashing gave a sort of firefly effect which was so distracting to others that the management had to prohibit the use of such portable lamps.



LAMP AND REFLECTOR USED BY A LONDON PHOTOGRAPHER TO BRING OUT THE DETAILS OF FEATURE AND COSTUME

Photographing Actors and Actresses

No people, as a class, pose more frequently before the camera than those of the stage; and certainly no one can be more particular about the perfection of the resulting pictures than the modern actors and actresses. It is not merely artistic pictures and faithful portraits that they want, but photos that will truly portray their individuality and that will show the richness of their garb to the minutest detail. For this purpose any direct sunlight is inadequate, as it leads to "flat" effects. To make the latter stand out, requires a diffused light which can be obtained during the day through windows facing northward by a proper manipulation of screens and curtains. Whenever there are clouds, or when the sun is low, even a fine north exposure of the studio will not give good results.

With the electric light, the available intensity (and therefore shortness of exposure) is easily under the photographer's control. And yet many users of arc lamps have fallen short of their artistic possibilities by exposing the sitter to the direct rays of the lamp instead of diffusing the light; consequently, some have concluded that the electric light could not equal the diffused daylight for the richness of its effects and the wealth of detail reproduced by its use. That this impression is far from true, is proven by the photograph of an English stage favorite reproduced herewith. This was taken in a fraction of a second by the intense light of an arc lamp having four pairs of carbons, the light being reflected and diffused from the interior of a dome-shaped reflector which is collapsible like an umbrella, being made of black gingham lined with a special twill.

This odd-looking lamp and reflector outfit as perfected by Marion & Co., Ltd., of London, is easily adjusted to throw the light just where it is wanted, the top of the reflector being usually about eight feet above the floor.

Mr. Thomas A. Edison celebrated the sixty-fourth anniversary of his birth on February 11 by a particularly busy day at his laboratory in Llewellyn Park, Orange, N. J. He received telegrams of congratulation from a number of the leaders in the electric lighting industry and other scientific fields.

Why Electric Light Bills Vary

The farmer has his busy season in the summer months. It is different with the electric light companies. They make hay when the sun does not shine.

The change in the seasons takes place so gradually that most people do not realize that the hours of darkness, that is the working hours of darkness, are nearly three times as long in December as they are in June. The exact relation between these hours is shown in the chart, which gives the hours of darkness between 6 o'clock in the morning and 10 o'clock at night.

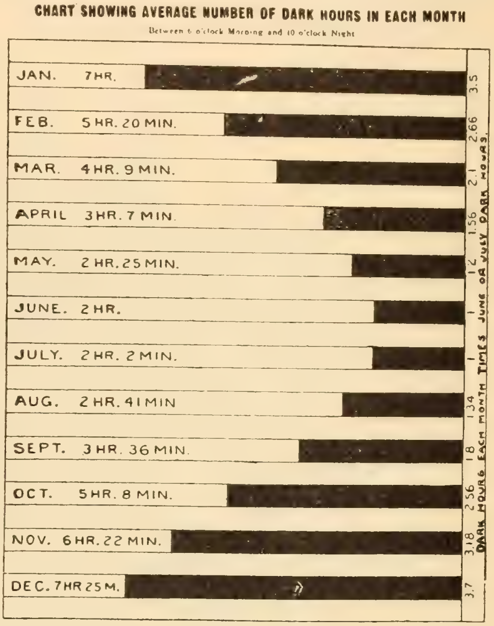


DIAGRAM SHOWING WHY LIGHT BILLS VARY

Naturally the amount of light used is not necessarily in exact proportion to the hours of darkness, but if people go to bed earlier in the winter they also stay out doors in the summer, which evens matters, so the light bills follow the chart fairly closely. This particular chart is true of the Great Lake latitudes. It was prepared by an electric lighting company to give its patrons ocular demonstration of why their light bills vary. Of course the moral is: "Do not rail at the lighting company if your bills increase as winter comes on." Instead, take your bills for a year back and see if their relation is not pretty nearly shown by the chart.

Most Artistic Display Sign Ever Built

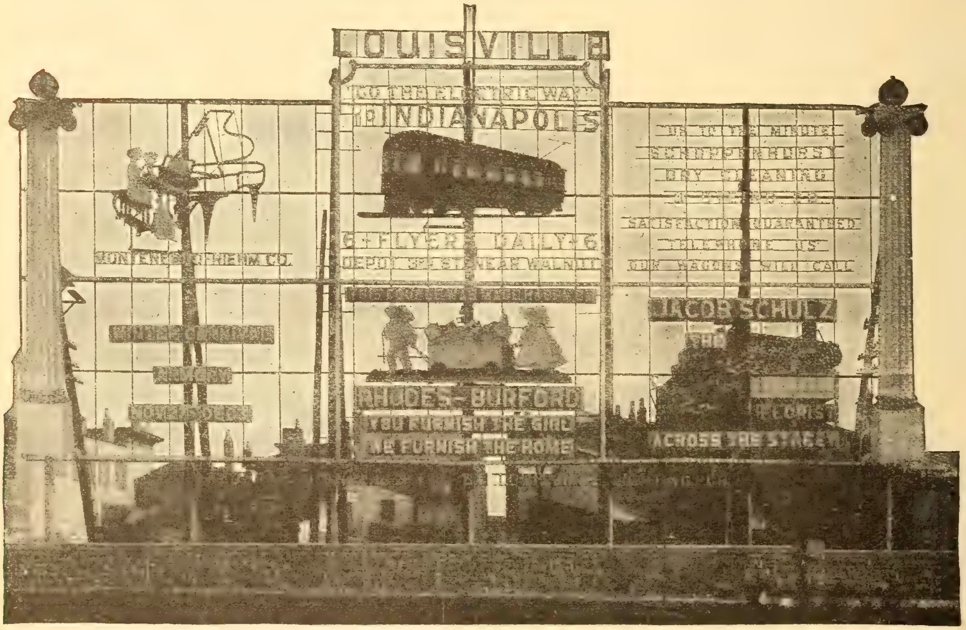
In this day of striking electrical display signs, it is unusual for signs of extraordinary size to combine as many unique and original effects as are shown in this mammoth display sign at Louisville, Ky., erected in Federal Park, where by actual count 20,000 people pass every night, between the hours of 5 and 11 o'clock.

The huge steel frame work of this sign, which is built by R. H. Frazier of the Federal Sign System, is 100 feet long and towers 60 feet into the air above the surrounding buildings. At each end is a massive Corinthian pillar forty feet in height, surmounted by a huge ball of wrought iron and art glass four feet in diameter. The sign is divided into six rectangular display spaces, each measuring 20 by 30 feet, upon which are built the various advertising displays. Over the sign the word "Louisville" is shown in huge letters.

The illumination is accomplished by means of 5,503 lamps and the color effects are startling in their beauty and effectiveness. Except for a few red lamps at the base and in the scroll in the capital, the two pillars are a blaze of white light, supporting the beautifully colored art glass balls which are lighted from the interior. The word "Louisville" and the strip lighting separating the panels are outlined in white light.

One of the display signs shows a pianist playing a grand piano, operated by a flasher which causes the player's hands apparently to move up and down the key-board of the piano and her body to assume different positions.

The street car is the most realistic moving effect on the sign and rivals in cleverness the famous chariot race sign in New Nork. The wheels of the car, outlined in blue lamps, revolve forward, and the track, outlined in white, apparently moves backward. Apparently the car is rushing forward at full speed, and its headlight (a 100-watt tungsten lamp) and the sparking trolley wheel adding to the realness of the effect. Suddenly a gong rings twice, the trolley stops sparking, the wheels cease revolving and the car stops.



LOUISVILLE'S ARTISTIC SIGN

A firm of electric contractors in London, England, has installed, as an advertisement, an electrically driven time ball which drops every hour. This is said to be the most reliable public time-piece in London.

The Story of a Skull

By G. A. WOOLSON

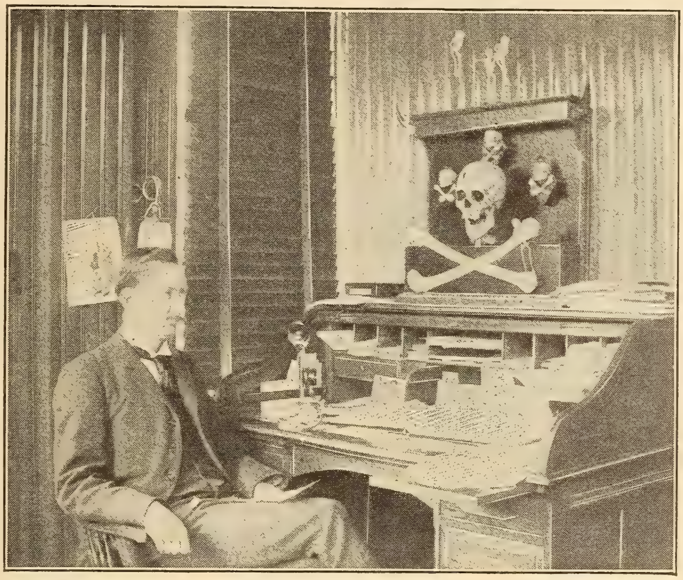
"Studying anatomy?" asked the insurance agent as he gazed at the skull and cross-bones on the ebonized panel over the desk.

"No," drawled Smyth, "I sometimes have commercial visitors or insurance agents that bore me and need a little help."

Smyth touched an unobtrusive button and the hideous bullet-pierced skull turned from side to side, the jaws opened and shut, and the eyes glared in fiendish glee.

The insurance gentleman took out the cigars and said, "Good afternoon."

"Are you disturbed by gruesome things?" asked mine host as he displayed the aforesaid ebonized panel with its weight of horror over his desk. The ghastly skull flanked by smaller composites thrown out in high relief by the somber background and velvet drapery which filled the open space black above, was a trifle startling. An electric button was again pressed and the illuminated skull gnashed its teeth and turned from side to side, and the little skulls followed suit. Lighted or otherwise, no thief or safe-breaker would linger long in the above presence.



THE GHOSTLY SKULL FLANKED BY SMALLER COMPOSITES

The history of the skull is briefly told:

Away back in the seventies, two New England men—Brown and Jones—had charge of ranches in New Mexico for several years. One season a couple of desperate-looking men attached themselves to their camp. One night Jones, who was apparently sleeping rolled up in his blanket, overheard a conversation between their uninvited guests.

"We have got to shoot Jones," said the giant of the pair, "he is getting suspicious of us."

"Hate to kill a man in cold blood," replied the other.

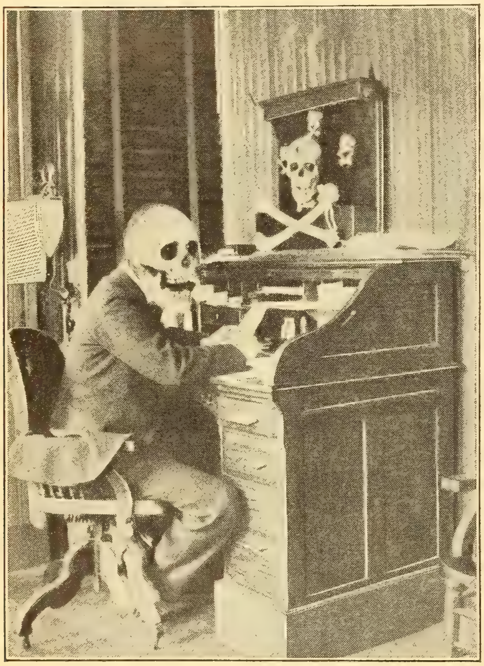
"Can't be helped. I am sure he is on our track. You watch your chance tomorrow and I'll watch mine; whichever gets the first 'll pop him over."

Jones waited until his would-be executioners were snoring like more worthy men, stepped between them with a revolver in each hand, and shot them both. One of the men proved to be Tom Taylor, a noted highwayman, for whom a large bounty was offered. The dead men were buried after the manner of the Wild West.

A few years later, when Brown and Jones were ready to quit the ranches for good, typical souvenirs of the rough life about to close were in order; consequently the skeletons were unearthed. Brown appropriated the skull and thigh-bones of Tom Taylor. The former is remarkable for size and extraordinary development of all but intellectual propensities. The unusual length of the latter bones indicates a height of nearly seven feet, a formidable brigand, as his record proved.

Later on, these important factors in the anatomy of the once powerful Taylor came into the hands of an eccentric genius, who, although lacking perhaps in reverence for "the dead past," is sufficiently optimistic and practical enough to re-animate the deceased Taylor in the following manner:

In the cabinet was mounted a small motor easily controlled from the chair in front of the desk. This motor operated a train of gears and an eccentric that turned a rod on which the skull was mounted; so as to make it face in different directions as a human head would be capable of doing. Another cam operated a crank that caused the jaws to open and shut with rapidity. A circuit-breaker interrupted the current that went to the red lamps in the eye sockets, thus giving the appearance of winking. This breaking was irregular so as to make the uncanny object at times wink rapidly and again stare for a moment. At the same time the little skeletons were operated by strings with due effect.



A LITTLE TRICK OF THE PHOTOGRAPHER

If the ghost of Tom Taylor should come "riding adown the gale," the temerity of the unscrupulous gentleman would probably be duly punished and what penalty could be more fitting than a transposition of skulls as shown in the second picture—a little trick of the photographer It is a curious fact that even facial expression of inanimate subjects is influenced by pose of body. "To see ourselves as ithers" *may* "see us," even by an odd trick of photography, is no doubt good for the soul.

From Coal to the Car

A small town in the middle west had enjoyed the benefits of a tiny central station for some years. The station consisted of one single cylinder engine and an old-fashioned dynamo. The position of chief engineer, which embraced a variety of duties, had been held by one man from the start. He was an Irishman, one Mike Flaherty. A small boy in the town developed some curiosity on the subject of electricity, and finally decided to ask the chief engineer for information.

"Mr. Flaherty," he said, "what makes electricity?"

Mr. Flaherty surveyed the youngster with calm scorn.

"And don't ye know that, even. Phwat for do ye go to school at all?"

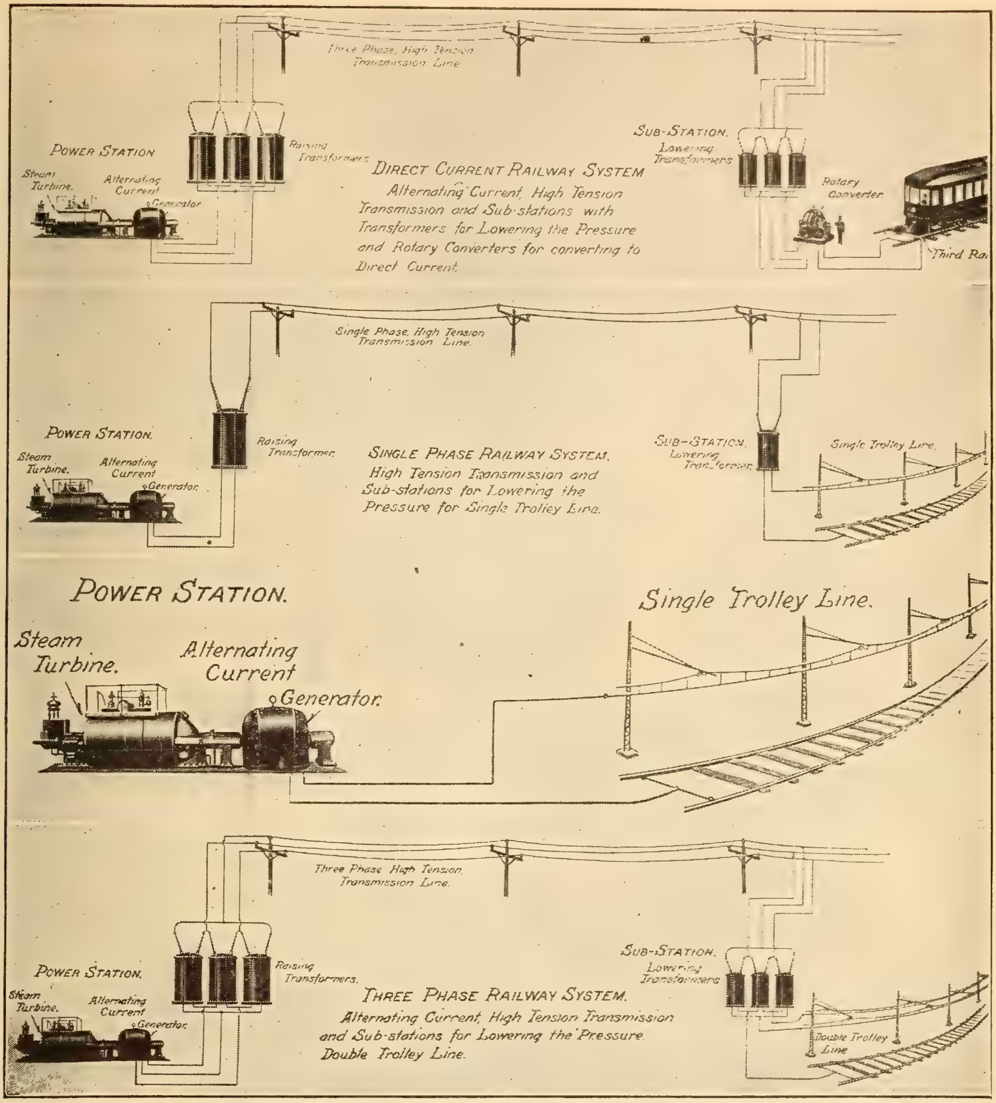
"But what makes it?" persisted the boy.

"Well, 'tis little time I've got to waste on the likes of ye, but out av pure goodness av heart I'll tell ye. If ye rub the side av a cat what do ye get? Sparks. Electricity. 'Tis the same with this masheen here. Them little sticks av carbon rubs on the copper armyture, and what do they get? Electricity. Fr-r-riction, I belave they call it. Yes, me boy, 'tis friction makes electricity."

And the boy went away inflated with wisdom.

Most people, or at least most readers of this magazine, know better than that, but there may well be a good many who do not understand exactly how electricity is transmitted from power houses to electric cars. In fact the pictures accompanying this article were prepared by Mr. George Westinghouse to illustrate a talk he delivered last summer before one of the greatest electrical societies in the world—the American Institute of Electrical Engineers.

The first diagram shows the essential parts of a direct current railway system. The electricity is generated at the power station at the left. It is what we call three-


Three Phase, High Tension Transmission Line
Power Station
Steam Turbine.
Alternating Current Generator
Raising Transformers
Direct Current Railway System
Alternating Current, High Tension Transmission and Sub-stations with Transformers for Lowering the Pressure and Rotary Converters for converting to Direct Current.
Sub-Station.
Lowering Transformers
Rotary Converter.
Third Ra
Single Phase, High Tension Transmission Line.
Power Station.
Steam Turbine.
Alternating Current Generator.
Raising Transformer.
Single Phase Railway System.
High Tension Transmission and Sub-stations for Lowering the Pressure for Single Trolley Line.
Sub-Station.
Lowering Transformer.
Single Trolley Line.
Power Station.
Steam Turbine.
Alternating Current Generator.
Single Trolley Line.
Three Phase High Tension Transmission Line.
Power Station.
Steam Turbine.
Alternating Current Generator.
Raising Transformers.
Three Phase Railway System.
Alternating Current, High Tension Transmission and Sub-stations for Lowering the Pressure. Double Trolley Line.
Sub-Station.
Lowering Transformers
Double Trolley Line

HOW ELECTRIC CARS SECURE THEIR POWER

phase alternating current. Yet the car is using direct current. Why, then, is alternating current generated at the power station? Because we can use transformers with it. Why do we want to use transformers? To change the voltage. Why do we want to change the voltage? Because the same amount of power can be transmitted with much smaller copper wires when high voltage is used. And copper is expensive. Also, since the current gets smaller as the voltage gets larger, and since the "line loss" varies with the square of the current, we do not lose so much power on the way when we transmit it at high voltage.

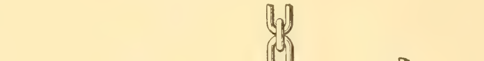
Because it is easier to build low voltage generators, we generate our electricity at say 440 volts, "step it up" to 6,600 for transmission, and "step it down" again where we want to use it. This is at the substation, shown to the right on the diagram. Then we change it to direct current by means of a rotary converter, and send it out into the third rail or trolley, as the case may be, usually at a pressure of either 600 or 1,200 volts. The current goes from the third rail through the motors and back over the other two rails.

The second diagram shows a single-phase alternating current system. It is a good deal like the direct current system we have just seen, except that we make single-phase alternating current at the generators in the power plant, instead of three-phase. We raise its voltage at the power house and lower it again at the sub-station. Then we feed it direct into the trolley wires, and it comes back through the rails.

If the distance between the power house and the cars is not great we can get along without transformers and feed the current from the generator directly into the trolley wire as shown in the third diagram.

The last diagram shows a three-phase railway system. It is exactly the same as the direct current system until we get to the sub-station. There we have transformers for lowering the voltage, but instead of having one trolley, we have two, for three-phase current has to have three paths to travel.

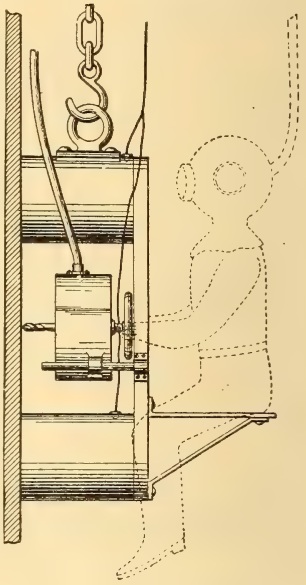
The direct current system is by far the most commonly used in this country. Next comes the single-phase, and after that the three-phase, of which the Cascade Tunnel electrification on the Great Northern Railroad is the only American example.



ELECTRICALLY EQUIPPED DIVING BELL

Lifting Wrecks From "Davy Jones' Locker"

When disaster sends a vessel to the bottom there is always the question of whether the cargo and ship will pay for the expense of raising. At present one means used in raising a vessel is to attach cables to the sides by hooks in portholes, or on projections, or to pass the cables beneath and lift the ship bodily. But difficulty is met in attaching cables, especially if the vessel is at a depth greater than that at which divers can work. Then ordinary methods fail and the vessel is considered lost.



MOTOR DRIVEN DRILL WORKING UNDER WATER

A patent granted to Robert O. King, Buffalo, New York, provides means for attaching lifting cables to a vessel even when sunk in water too deep for a diver in his helmet. The equipment consists of a strong metal spherical diving bell or ball into the side of which is built a drilling machine operated by a motor inside. The bell is large enough to allow one or two men to work. Air is supplied through piping from above, the operators not suffering in consequence from high air pressure. Water in a lower compartment regulated by tanks of compressed air is used for ballast. An electric cable runs the drill motor and energizes electromagnets on the side of the bell holding it firmly against the armor plate of the vessel when necessary. Powerful lights may be directed through the windows of the bell and a telephone line enables the divers to communicate with their helpers.

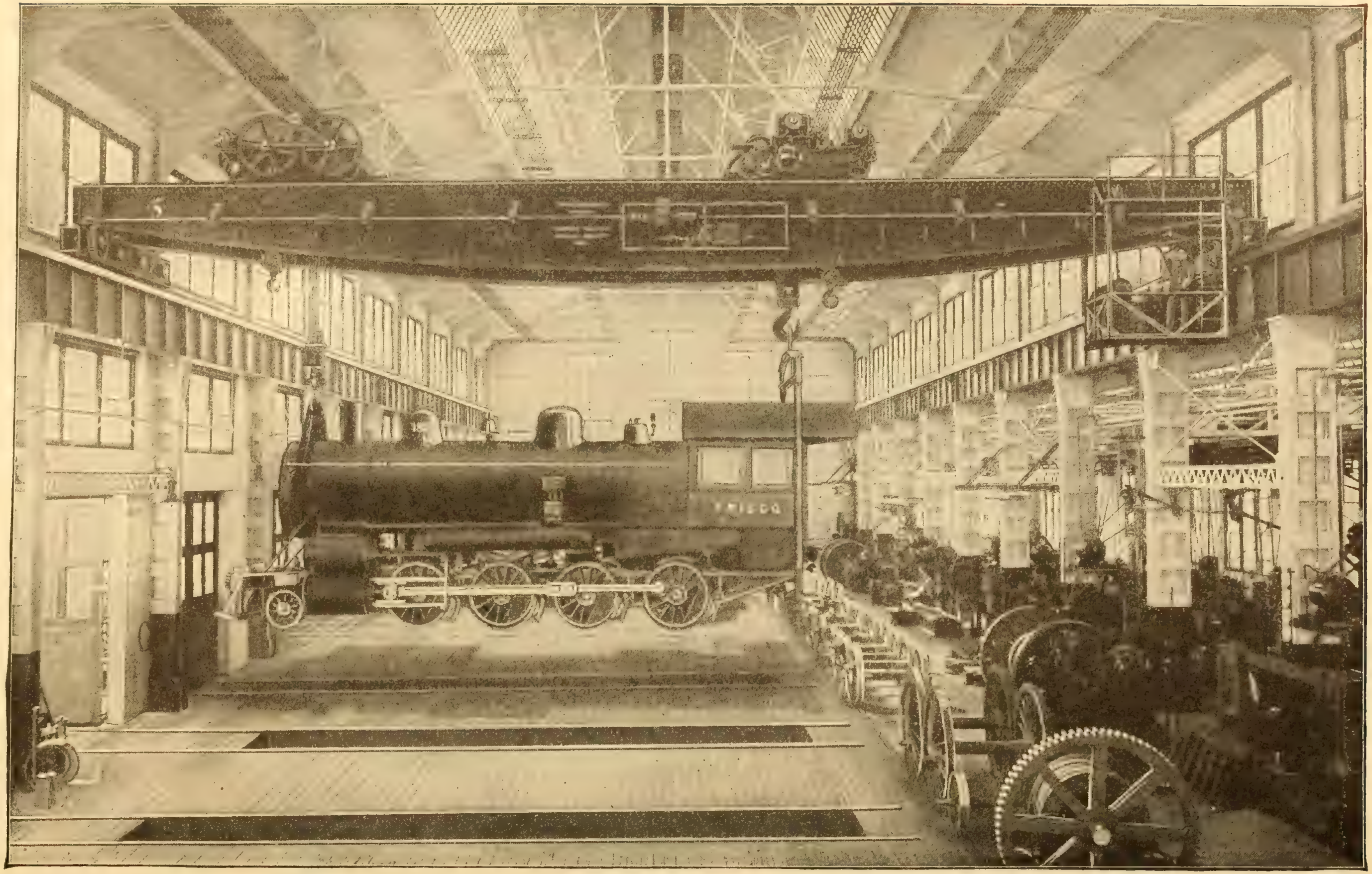
The second illustration shows the device built for operation by a diver in helmet when the wreck is not in too deep water.

Artistic Shadow Dancing

In reviving shadow pictures, the Palace Theatre at London has departed widely from the crude farce effects and the "horse play" that have characterized the shadow performances with which we are all familiar. Instead of presenting burlesque pantomines, the new shadow effects are catering to the same high taste which appreciates the best that sculptors have produced in ancient as well as modern times — lines of beauty, gracefulness of movement and rhythm of action. To attain the artistic in shadow effects has proven far more difficult than in the ordinary stage dancing, as the lack of color schemes and of a second dimension to give a depth and setting to the picture impose rather severe limitations. Indeed, some of the popular stage diversions, such as clog dancing, skirt dancing and even the ballet for this reason lose much of their artistic effect when presented in the shadow form.

ELECTRICITY MAKES POSSIBLE ARTISTIC SHADOW DANCING

Thanks to the ease with which electric lighting lends itself to all sorts of stage effects, the setting is no longer as bare or as colorless as it was with the shadow pantomine in which many of us took part as amateurs when we were younger. Instead of a vast, uniformly bright screen the picture now stands out against a bright background gradually shading off to a dark border, giving the artistic blended effect as of a vignette in a photograph. Nor is it entirely void of color, as the use of colored slides before the spot lights make the shadow figure stand out in the complementary color: dark green against a pink back ground, brown against a greenish screen, and so on. In some cases it has even seemed appropriate to have another lamp project a suitable picture on the screen as a background for the dance; as for example, a temple scene for some of the Greek dances. Indeed, so many different effects are obtainable by a judicious use of electric lights that it should be easy to satisfy a wide range of tastes; and if the artistic shadow dances which have already charmed London audiences also set a new standard for stage grace in America, this may be due in no small measure to the lighting effects without which the shadow pictures of earlier days were limited to hurly-burly presentations.



ELECTRIC CRANE CARRYING 187,000-POUND LOCOMOTIVE

Playing With a 93-Ton Locomotive

On the opposite page is a picture showing how a modern electric crane is able to pick up and carry about a locomotive weighing 187,000 pounds. The span of this great traveling crane is 74 feet and the vertical lift 29 feet. The entire weight is carried by a pair of massive steel girders which run on wheels on two girders at the sides of the erecting room. The lifting hooks are raised and lowered by motors mounted on the carriages on top of the crane. These motors are all controlled to a nicety by the man in the cage at the right end of the crane. There he stands in his majesty and by the manipulation of a few levers and switches he lowers away the hooks, picks up the 93-ton mogul and moves quickly and silently down the long room.

The Honey Bee a Live Battery

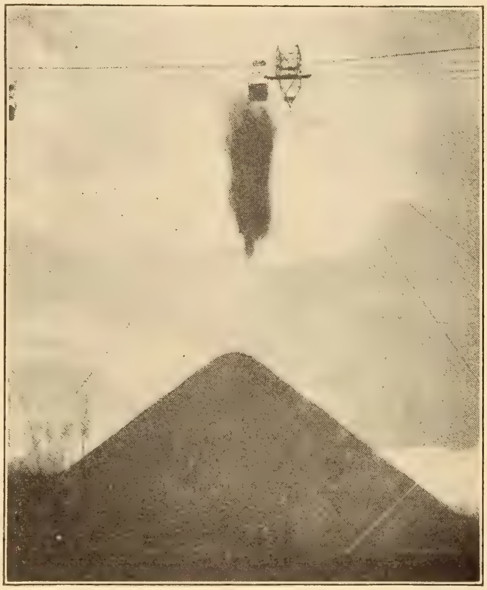
In the following letter from Mr. L. K. Smith, of Grant, Fla., there is the germ of an idea for "electro-naturalists" to investigate. He writes:

"GENTLEMEN: Your magazine is a live wire. The article 'Live Batteries,' page 376, by W. H. Miller, is of special interest to me in the description of these fishes' storage batteries, for it solves the problem of the honey bees stinging without injecting any of the contents of the venom sac. After handling bees eighteen years I note the similarity in the shock imparted by the ignition system of gasoline motors and that of the impact of an angry bee, and I ask myself this question: Has the honey bee a battery in the flakes of wax which it secretes along the sides of its abdomen in thin narrow flakes separated by the telescope-like sections of the abdomen? And at this moment I am convinced that the honey bee is a live battery although not able to prove it by an experiment with electrical apparatus."

Most of us are aware, from experience, that when an angry bee, coming full tilt, hits us in the face, something more than a tickling sensation is felt, even though the bee does not pause long enough to do any real stinging. Whether the feelings so excited are the result of "nerves" on the part of the person being bombarded or are in reality caused by an electric shock no one, to our knowledge, has ever explained. It is conceivable, however, that the busy bee, whose wings beat the air with tremendous rapidity, may constitute within himself a little machine for the generation of static electricity, after the manner of clouds, which generate great quantities of such electricity through friction with the air. Then, given a little leyden jar of telescopic wax flakes, as suggested by Mr. Smith, he might be ready to do business.

Caught in the Act

This unusual photograph was taken at the Thetford Mines in Quebec. It shows very graphically the methods employed in disposing of asbestos chats, a waste material produced at the mines. Ninety tons of this waste are handled in an hour by the buckets of the electrically operated aerial tramway.



CAUGHT IN THE ACT

Two cables on which the carriers travel are supported by towers 100 feet high. Below the carriers are the endless traction ropes, operated by motors at the loading station, which drag the carriers with their buckets out over the line at the rate of 250 feet a minute. Each bucket holds 1,500 pounds of chats, which, at the proper moment, is automatically tripped and dumped on the waste pile as shown in the illustration.

Electric Locomotive the Largest

One of the great Westinghouse electric locomotives, of which nine more have just been added to the equipment of the Pennsylvania railroad, is shown just leaving the tunnel in New York City. These locomotives are by far the largest ever built. They weigh 312,000 pounds or 156 tons. Each driving axle weighs 50,000 pounds. They are of the articulated, double-cabin type with a total wheel base length of 55 feet, eleven inches. The maximum draw bar pull (recorded test) is 79,200 pounds; normal speed with full train, 60 miles per hour. The two motors on each locomotive, aggregating about 4,500 horsepower, turn the drive wheels by means of cranks and connecting rods.

ELECTRIC LOCOMOTIVE WHICH WEIGHS 312,000 POUNDS

Magnetized Rails Upset Compass

Leaving Gary, Ind., with a cargo of steel rails, bound up Lake Michigan, the captain of a lake vessel was recently surprised to find after steering for twelve hours steadily by his compass and the chart that his ship had approached within a mile or two of the west shore when by his reckoning he should have been almost in mid-lake. After correcting his course and steering carefully by landmarks and stellar observations during the remainder of the voyage, he reported the peculiar behavior of his compass and found that this load of rails had been loaded by electro-magnets from the rail mill to the flat cars used to run onto the docks. The rails are lifted by huge horseshoe-shaped electro-magnets and sufficient magnetism had remained in them from this momentary magnetization to deflect the compass more than a point when stacked end to end in the hold all in the same direction. The trouble might be averted, of course, by reversing alternate cars as the rails are loaded into the vessel.—*Electrical World.*

Electricity

I my destiny fulfill,
Servant to the human will;
I am yet the fleetest courser,
I am first in speed and skill.

Everywhere my track is free—
Over mountains, under sea;
Through the world's remote dominion
South and north are one to me.

All that sundered lives require,
All they proffer and desire,—
Swift as light I waft their message,
Speed their thoughts along the wire.

From the ship by danger pressed,
O'er the ocean's heaving breast
I, its hope in hour of peril,
Flash the tidings east and west.

On through time the earth will roll,
Yet am I its life and soul;
Over it my thought pulsations
Knit all lands, from pole to pole.

EUGENE C. DOLSON.

Electricity in German Breweries

By DR. ROBERT GRIMSHAW

The brewing industry has reached the high stage of perfection which now characterizes it by the fact that it has not confined itself to utilizing the results of experience and researches in malting and brewing alone, but has drawn on many other industries for improvements all along the line—technically and commercially. In this connection, electricity in the arts has not been forgotten; and the illustrations here given (by the courtesy of the Siemens-Schuckert Works) show this progress in various branches of the business.

In the first place, illumination, which is of great importance in brewing, has received due consideration. In Fig. 1 we see the "mash room" of the Thomas Brewery in Muenchen, lighted by arc lamps, and Fig. 2 the corresponding machinery-room immediately below it with incandescent lighting.

The introduction of electric drive for the machinery has found great favor by reason of the simplicity which it brings with it, as well as on account of the saving thereby achieved. Figs. 2 to 4 inclusive show electric drive in several parts of a brewery, the motors being of a special type, designed with due regard to the particular conditions under which they work. For instance, the winding of such motors as run in damp rooms must be protected by a special device against dampness. Where the motor requires protection from mechanical injury or from dropping or spraying water, or where for any cause the touching of a current-carrying part is to be prevented, it is covered with a protecting casing as seen in Fig. 2. Where there is a great deal of water about, the motors are fully enclosed, as seen in Figs. 3 and 4.

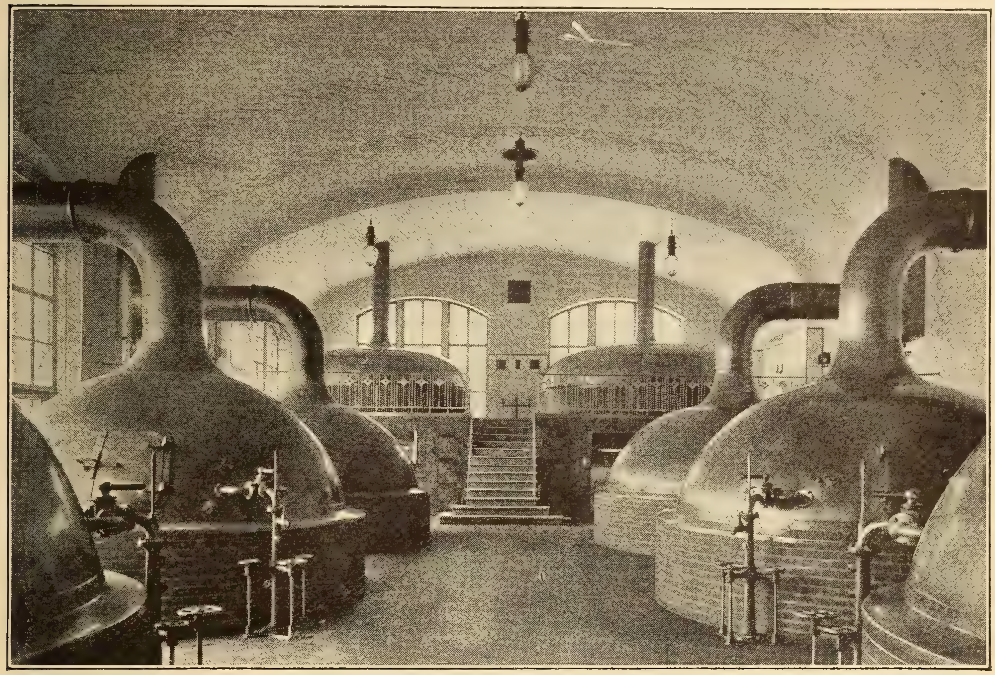


FIG. 1. THE "MASH ROOM" IN A GERMAN BREWERY—ILLUMINATION BY ENCLOSED ARC LAMPS

In the same way, such electric apparatus as switchboards, safety appliances, starting devices, etc., are protected by a hood or

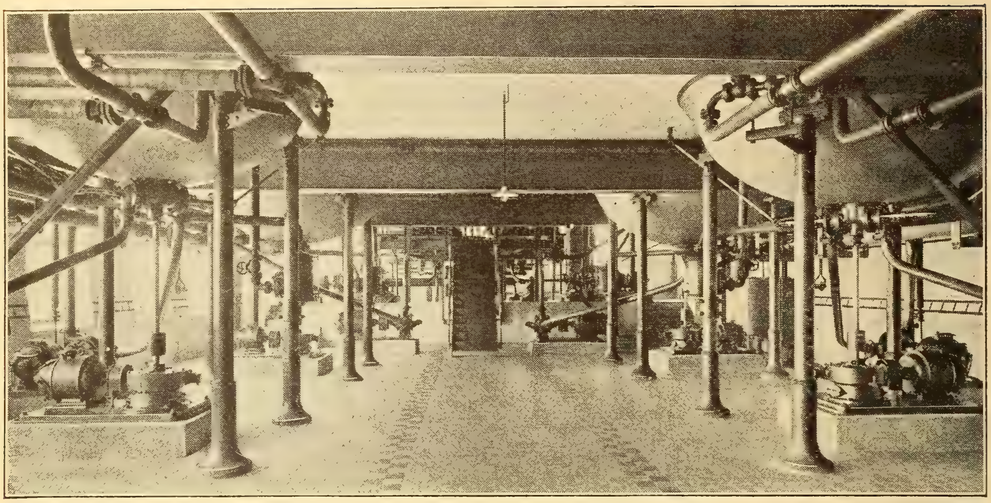


FIG. 2. SHOWING THE ELECTRICALLY DRIVEN PUMPS DIRECTLY BENEATH THE GREAT RETORTS IN THE "MASH ROOM"

casing, to exclude moisture and also prevent injury to the attendants.

Among the examples of electric drive may be mentioned that of the mashing pans and the mash pumps. Fig. 2 shows for instance, the employment of motors for this purpose in the mash department of the brewery above mentioned. To drive the stirring device there are necessary motors of from four to eight horsepower, with rotation speeds which are regulatable within very wide extremes. The machinery is started from the mash-tub house by hand-wheel, shaft and gear-wheels. In the back-ground in Fig. 2 there can be seen the motor for driving the cloudy mash pump, spent malt machinery, etc.

Other machines which are electrically

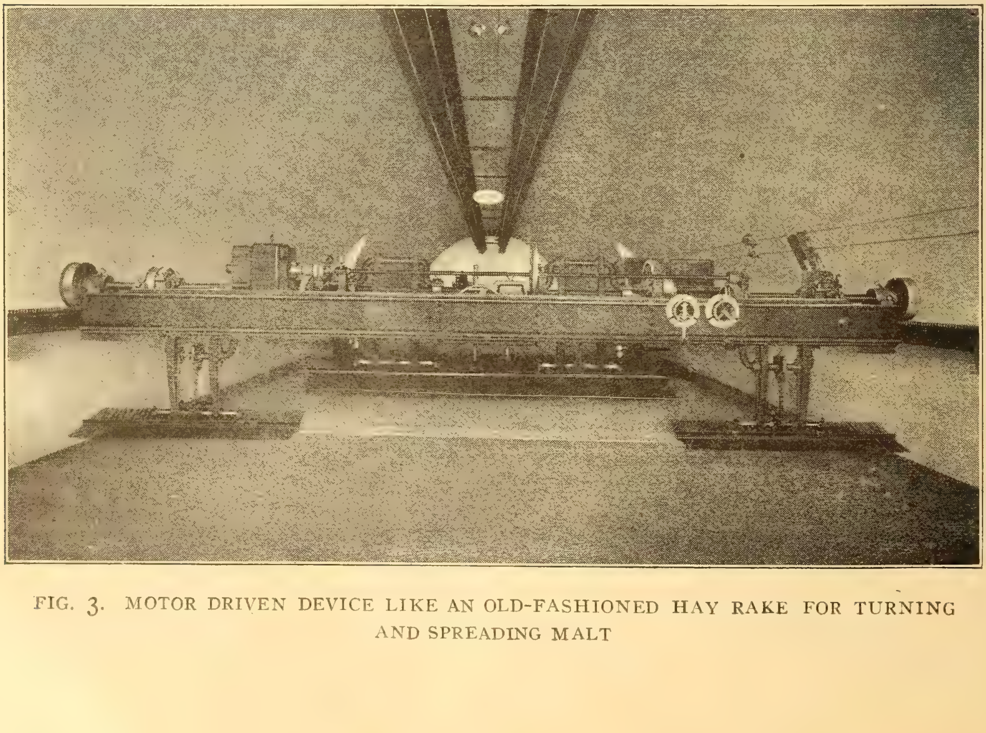
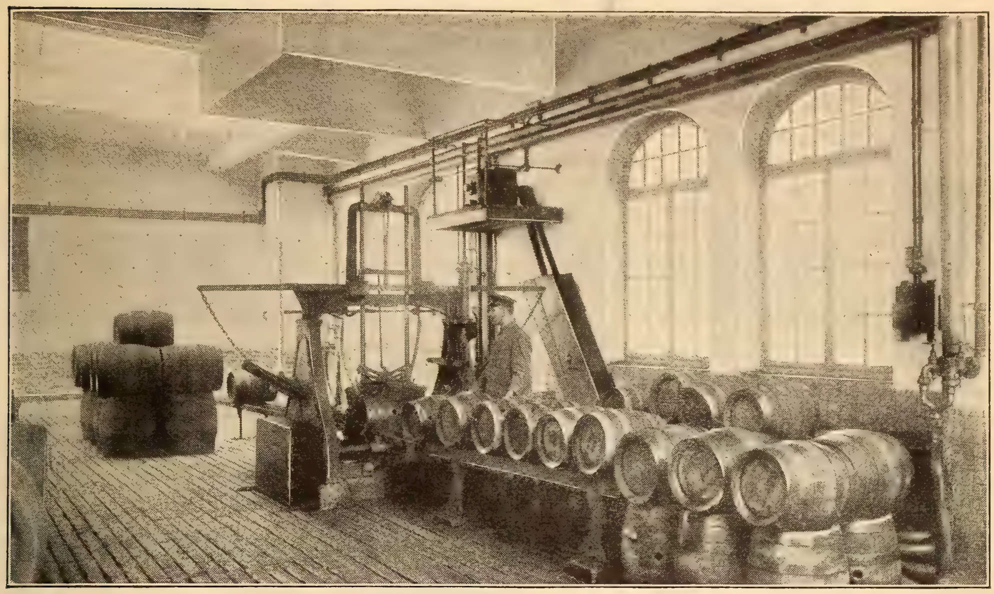


FIG. 3. MOTOR DRIVEN DEVICE LIKE AN OLD-FASHIONED HAY RAKE FOR TURNING AND SPREADING MALT



ELECTRICALLY DRIVEN MACHINE WHICH WASHES KEGS AND BARRELS

driven are those for mixing, washing and ventilating, removing the germs and polishing the grain, the grinding mills, and the apparatus for the spent malt.

A very important application of electricity is in the mechanical malting rooms, where the material is spread and the green malt turned by a sort of electric traveling crane from which are suspended devices something like old-fashioned hay rakes. Also the washing of the malting-floors, the leveling and turning of the malt heaps, as well as the transportation of the cars to the malt-turners, is electric, effecting a very great saving of labor. Fig. 3 shows a malt turner driven by motors.

Among other electrically driven machinery may be named the vacuum pumps, that for handling the spent grains, etc., and in all the various processes connected with storing and shipping, electricity is used as far as possible to save hand labor. Fig. 4 shows, for instance, the electrical drive of a barrel-washing machine in the Paulaner brewery, Muenchen. This machine is driven through a countershaft by a 2.8 horsepower enclosed electric motor, standing on a bracket. The barrels are washed outside and in without any attention on the part of the workmen; so that the thoroughness of washing is not dependent on the workmen's attention or conscientiousness. The machine for pitching the interior of the kegs, washing out the bottles and pasting on the labels are electrically driven.

It is therefore evident that there is hardly in the brewery a single machine for driving which electricity may not be used to simplify and cheapen the application of the power from the prime mover.

Electricity Wrongly Accused

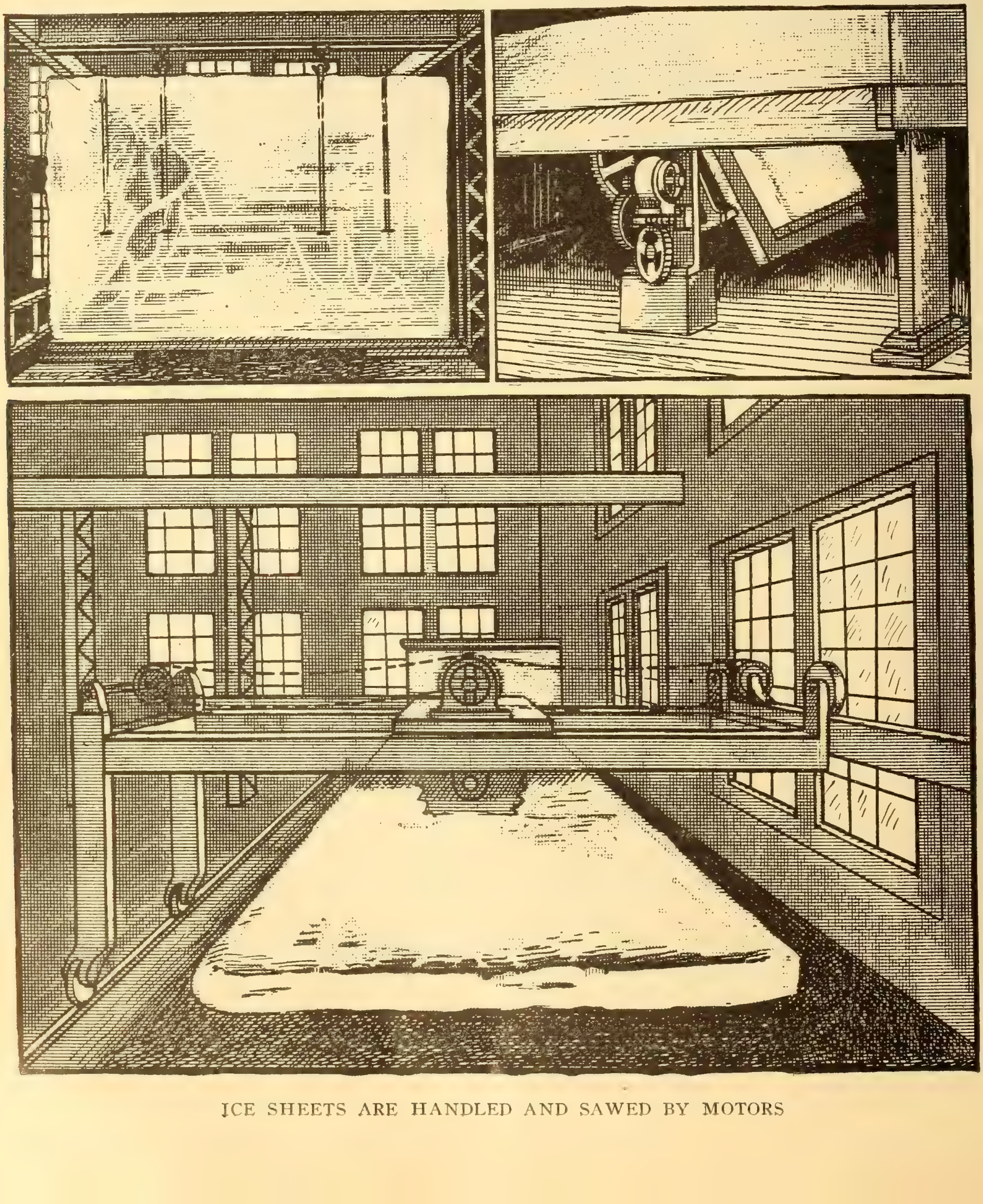
The hue and cry that electricity is a great fire hazard has no foundation, in fact, as is so often proven by the fire reports of large cities where electricity is extensively used.

According to the report of the New York Board of Fire Underwriters electrical fire losses were extremely small for the year 1910. But 24 fires out of the large number investigated were caused by electricity, the property loss being only $27,530. Five fires were due to short circuits; nine to grounds on gas or other piping; two to sparks thrown from operating switches; three to overloaded circuits; one to defective joints; one to loose contacts and one to the heat from an incandescent lamp placed on inflamable material. Of two causes under this head resulting in no damage, one was due to an explosion of an incandescent lamp in gasoline, the other to the igniting of a moving picture film.

Handling and Cutting Ice Sheets

In a plant where artificial ice is made it is interesting to study the methods of handling the product, now done principally by the power of electric motors. In the first place the ice is frozen in huge sheets as large as the size of a good-sized room. To facilitate handling eye-bolts are frozen into each sheet by means of which the latter is picked up by an electric crane as shown in the first picture. Then it is easily transported to a tilting table, also operated by a motor as shown in the second picture. By means of this table the ice sheet is lowered and slid on to the cutting floor without breaking or cracking.

Over the cutting floor a buzz-saw, carried by a movable bridge, is arranged to travel back and forth along the bridge, cutting through the ice as it goes. The motor just above the saw not only turns the latter but furnishes the power for propelling it across the bridge.



ICE SHEETS ARE HANDLED AND SAWED BY MOTORS

Timing Bullet Speeds

By ALBERT SCHEIBLE

The simplest method of testing the efficiency of different powders for propelling firearm projectiles consists in comparing their initial velocities when forced from the same bore by these different explosives. In other words, if we set a screen or target at a fixed distance from the muzzle (say 100 feet or 100 yards) and find the exact time which it takes the projectiles to reach this target, we will have a comparison of the initial velocities from which we can judge the effectiveness of different powders.

In making such comparisons, electricity has long played an important part, being used in widely varying ways. For instance, one of the methods used in the 70's employed as a target a screen supported by an electromagnet and released at the moment of firing so that the bullet would strike higher on the screen than if this had been stationary. To make sure that the release of the screen would be simultaneous with the firing, the trigger of the pistol or gun was extended to make a contact through which the current passed to the magnet (Fig. 1). When the trigger was pulled, the circuit was opened and the magnet let the screen drop so that the bullet instead of striking at (A) would pierce the screen at (B). The vertical distance between (A) and (B) would depend upon the time spent by the screen in falling, which was equal to the time spent by the bullet on its way, assuming that the breaking of the contact took just as much time as the stroke of the hammer and the exploding of the cartridge. The time that the screen was falling is easily determined by the distance through which it fell before it was struck by the bullet (from the law of falling bodies). However, any variation in the interval of time necessary for the hammer to act and the cartridge to fire, might change the results materially, as the time intervals involved were all quite small. So this method was improved by having the magnet circuit broken, not by a contact on the trigger (which might act before the shot was actually fired) but by a fine wire or gauze which the bullet pierced immediately after leaving the muzzle.

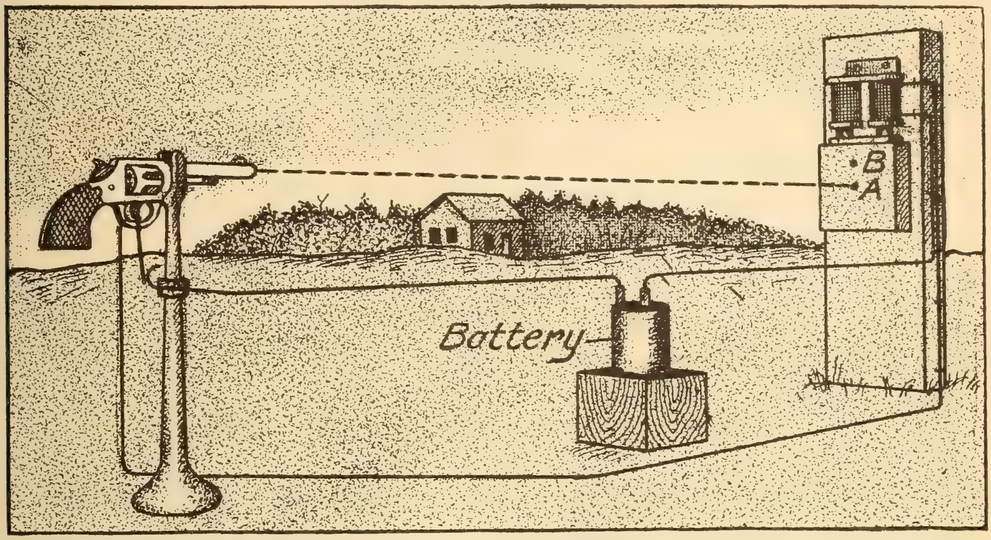


FIG. I. ONE WAY OF TIMING BULLET SPEED—BY FALLING TARGET

In more recent years various other methods of timing the speed of projectiles have involved the same principle of measuring the time over long distance, so that these tests usually had to be made out of doors. The long ranges were used because they made the time interval longer so that any errors in recording the time would be much smaller in proportion to the elapsed time than they would be for the short ranges. If smaller lapses of time could be measured with equal accuracy, the testing might be done at short range and much more conveniently. This has lately been made possible by a new bullet-velocity meter brought out by one of the most prominent European makers of electrical measuring instruments, Hartmann & Braun, Frankfort, A. M., Germany. The new device works on the principle that if you shoot a bullet diametrically through a thin paper drum or cylinder (as in Fig. 2) the point (B) at which the bullet leaves the cylinder will be diametrically opposite the point at which it entered. Now if this cylinder was rapidly rotating in the direction indicated by the arrow, the point (B) would no longer be opposite the entering point by the time the bullet reached the other side of the cylinder, so that the bullet would pierce the latter at a point (C). Then the distance around the circumference between (B) and (C) would depend on the time it took the cylinder to rotate that distance, this being equal to the time spent by the bullet in passing diametrically across the drum. By having the cylinder rotated at a fixed speed (say 2,000 revolutions per minute) it is easy to calculate this time and thus determine the speed of bullets without resorting to long ranges and cumbersome apparatus.

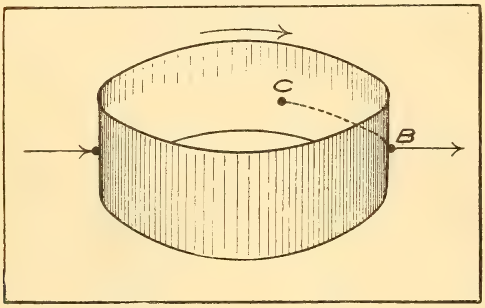


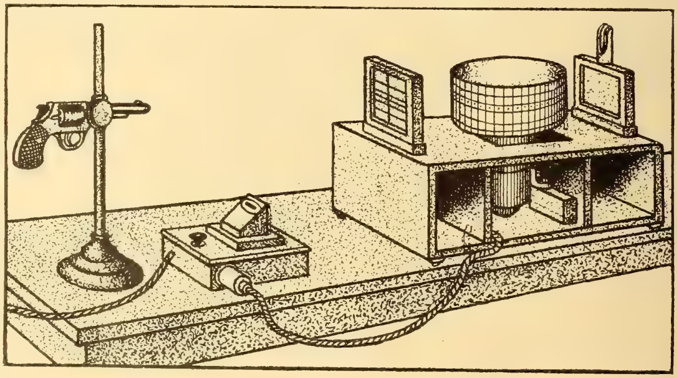
FIG. 2. PRINCIPLE OF THE HARTMANN-BRAUN BULLET TIMER

Of course the reliability of this method depends on getting an accurate record of the speed at which the drum rotates.

For this purpose the simpler types of speed indicators are not as accurate as many other laboratory devices, as for instance those used for telling the rate at which an alternating current changes its direction. The makers of this device therefore adopted the ingenious plan of letting the shaft of the drum produce an alternating current whose pulsations will be equal in number to the rotations of the drum. This is done by a simple commutating device on the shaft of the drum, from which wires run to the "frequency indicator" pictured just to the right of the pistol in the cut A knob on the base of this indicator adjusts a resistance so as to vary the speed of the motor.

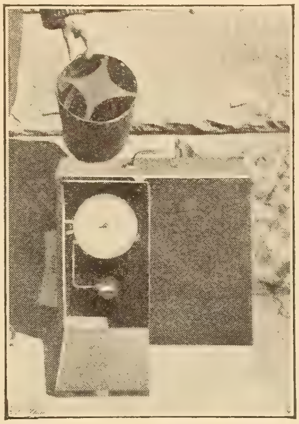
All the operator has to do, after starting the motor is to adjust the speed till he gets the desired reading on the frequency indicator and then fire the shot.

In practice, the shots do not always pass exactly over the center of the drum and allowances have to be made for any deviations from the proper firing line. For this purpose flat screens of thin, ruled paper are placed on either side of the drum and the bullet holes in these show the actual course followed by the bullet. Then it is easy to determine the angle of rotation through which the drum has traveled by applying a straight-edge between the holes in the two screens.



HARTMANN-BRAUN BULLET TIMER READY FOR A TRIAL

Electricity Saves Fruit



ELECTRIC ALARM AND SMUDGE POT

Fruit growers will welcome the electric frost alarm, which by its timely warning will save thousands of dollars' worth of fruit from freezing, and yet allow the orchardists to sleep nights instead of sitting up to watch a thermometer. The device is small and compact, having a certain resemblance to a clock in a square case, and it is equipped like a clock with two hands. One of these registers the degrees of temperature, while the other is set at the danger mark, which differs for the various fruits. When the thermometer hand reaches the point at which the alarm hand is set, a bell rings and continues ringing until the sleepers are aroused and shut it off. The electric thermometer is placed in the orchard and connected by wires with the sleeping quarters of the ranch foreman or whoever is responsible for the frost protection.

ORCHARD PROTECTED FROM FROST BY SMUDGE POTS

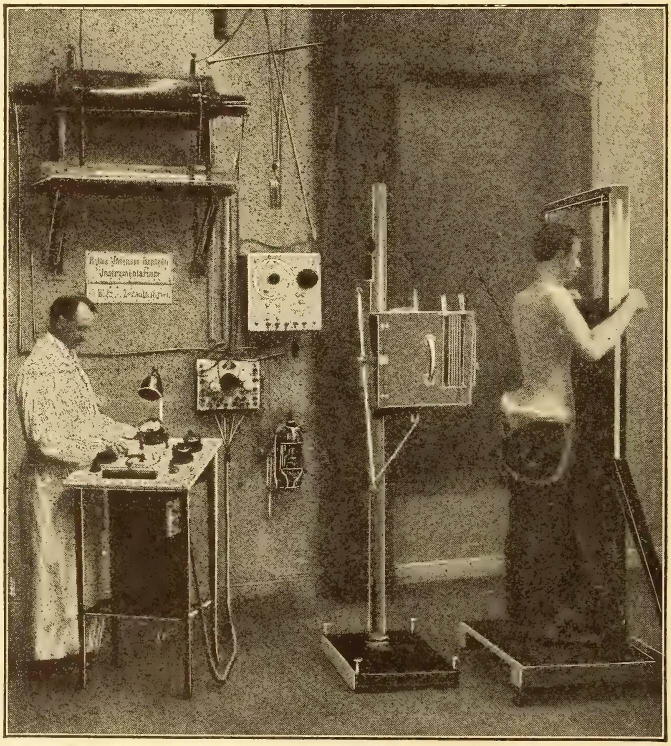
This device is operated in connection with the oil-burning smudge pot, extensively used by fruit growers in California and Florida. These pots are placed between the rows, about one hundred of them to an acre, and as they are kept filled and in readiness the laborers merely apply a torch to each, and the resulting heat and movement of the air prevents the frost from settling.

At the Moose Mountain workings in Ontario, Canada, an electro-magnet has taken the place of a steam shovel for loading iron ore. The ore is first broken up by blasting, and then picked up by the magnet, 800 pounds at a time, and loaded into cars. This saves the expense of new buckets formerly worn away by the hard ore.

X-Ray Pictures of the Stomach

By DR. ALFRED GRADENWITZ

Considerable difficulty has been so far experienced in obtaining X-ray pictures of the stomach, on account of the characteristic ("peristaltic") motions of that organ. Unless therefore the duration of exposure be reduced to a minimum, the outlines of the X-ray picture are liable to become blurred, thus wiping out any finer details. Another necessity difficult to comply with is to provide for a visual X-ray examination being made previous to the taking of an X-ray picture, so as to get an adequate idea as to any constrictions and expansions in the walls of the stomach. Again, as the X-ray picture should be taken immediately after radioscopic observation, the outfit should contain a simple switch allowing it to be made ready at a moment's notice for either operation.



TAKING AN X-RAY PICTURE OF THE STOMACH

The outfit constructed by a Berlin company effectually eliminates all these difficulties and is equally suitable for radioscopic and radiographic work (flash-light, instantaneous and long-exposure views) as well as for therapeutical radiation.

The outfit merely comprises a high-intensity induction coil mounted on two brackets, a quick-break switch, a Rotax interrupter and a distributing board connected with a switching desk. A special universal stop allows the intensity of X-ray radiation to be readily adapted to any special conditions. When experimenting on persons in an upright position there is used a vertical support comprising a universal slide against which the subject is placed. The apparatus is operated as follows:

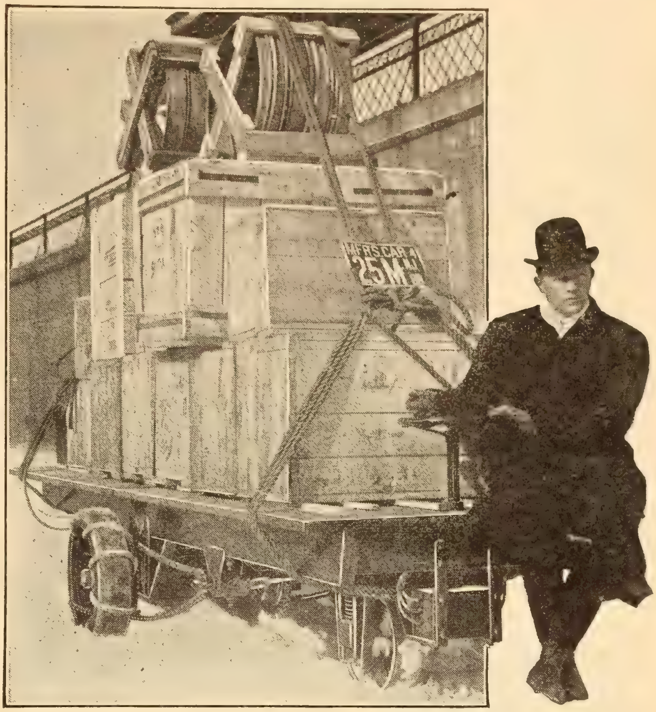
After having taken a "bismuth meal" (diaphanite or bismuth) required for any X-ray photography of the stomach, the subject is examined radioscopically immediately after which an X-ray picture is taken. After adjusting the switch to instantaneous working, the time of exposure is adjusted for on the scale and the apparatus is thrown into circuit.

Since the first of the year the National Bureau of Standards has adopted a new value for the standard volt in this country to correspond with that in England, France and Germany. The change, while numerically very slight, will be felt in the incandescent lamp industries. The change is based on the value of the Weston cell at 20 deg. C. Heretofore we have rated the cell at 1.091 volts; now the rating is 1.0183 volts.

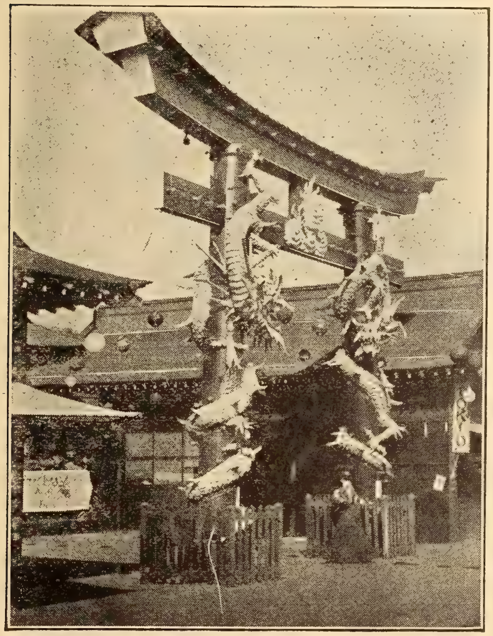
The Electric Stevedore

The big stevedore who pushes trucks around the freight houses, and whose chief strength is physical rather than mental, will have to look for another job if other companies follow the lead of those along the New York docks, where the electric freight truck is being used in his place.

This truck carries its own power in storage batteries. It is hinged in the center and can get over almost any inequality or scoot around a corner like a big caterpillar. It will run eighteen miles on a single charge at a maximum speed of 4½ miles per hour. Two tons of freight makes a nice comfortable load for it but it can carry four tons at a pinch. It has solid rubber tires and can be steered from either end. The operating cost with current at six cents per kilowatt-hour is about ten cents per mile.



THE ELECTRIC STEVEDORE



A STARTLING GATEWAY

A Startling Gateway

A remarkable specimen of grotesque art is the dragon gate at Venice, California, which stands before the Oriental pavilion of that resort. It has a height of about 20 feet and is in the type of Japanese portal made familiar by "tea gardens," but the startling feature of it is the pair of huge gilt dragons coiled around the upright posts and apparently hanging on by their murderous looking claws. These dragons are brightly gilded and with their menacing fangs and bristles form the substantial theme for a nightmare. As they are brilliantly lighted by incandescent lamps that follow their sinuous course around the posts, they are as spectacular by night as by day.

The Indianapolis & Louisville Traction Company has taken a novel method of advertising, with the intention of reducing the number of accidents. In carrying out the plan, blotters bearing a list of the most common causes of accidents have been distributed among the school children in the vicinity of the company's lines.

From Out the Leyden Jar

The Vandalia Railroad recently conducted an interesting experiment with the telephone as an aid to freight-train operation. On a freight train of 123 cars, one and a half miles long, drawn by two engines, a telephone wire was strung along over the tops of the cars, connecting telephone instruments in the caboose and engine cab. The movement of the train was directed by the conductor who, sitting in the caboose, telephoned his orders up to the enginemen.

* * *

The Colonial Sugar Co. is about to establish a system of wireless telegraphy at its mills in the Fiji Islands. The mills are situated on different islands, and some of them are hundreds of miles apart. Their steamer "Fiona" is also to be fitted with wireless apparatus. When the installations are completed at all the mills communication will be maintained between all the company's properties, and will enable the "Fiona" to be advised by wireless at which island she is required to call.

* * *

Two new telephone lines between London and Paris are being opened for public service and two more are promised in the spring. With the new lines in operation around 400 conversations per day can be transmitted between the two capitals.

* * *

An electrical teleprinting apparatus enables the Berlin police to print notices in 200 stations in the city and its suburbs simultaneously.

* * *

One million electric lights glow in Los Angeles every night, as shown by the connection records in the city electrician's office.

* * *

The experiment made by the Canadian Pacific Railway in train dispatching by telephone has proved so satisfactory that a further 2,000 miles of track is to be fitted with telephones for this purpose, making a total of 4,254 miles in operation.

* * *

A platinum mine was recently opened between Pecos and San Antonio, Tex., and a shipment of the ore has already been made to Boston.

The principal forms of tungsten ore are tungstates of iron, manganese and calcium; more rarely of lead. Tungsten trioxide is a bright yellow powder, which is almost insoluble in hydrochloric or nitric acids; hence by boiling the suspected mineral with hydrochloric acid, the presence of tungsten may be detected by the appearance of the bright yellow precipitate. With the addition of metallic tin or zinc the trioxide is further reduced, the lower oxides showing successive colors of blue to brown.

* * *

Canada purchased from the United States in the eight months ended November 30, 1910, electric insulators and batteries and telephone and telegraph instruments valued at $2,417,569 and only $53,209 from all other countries.

* * *

The Navy department is planning to establish a wireless system along the Aleutian islands, according to advices from Washington. The system, when established, will naturally work in harmony with the present wireless system operated in Alaska by the Signal Corps of the Army in connection with the cable which places Alaska in communication with the outside world.

* * *

The Illinois Traction System is preparing large excavations made in the ground at Riverton and Mackinaw which will be filled with coal, and afterward covered with water to shut out the air. Each reservoir will hold about 12,000 tons of coal and will be lined with cement.

* * *

The largest telephone exchange building in the world is to be erected soon at a cost of about $1,500,000, by the New York Telephone Company.

* * *

The wire guessing contest at the Chicago Electrical Show which waged fiercely about the pillar built of spools of wire was won by Prof. John D. Nies of the Lewis Institute, Chicago. His guess was 19,415 feet, while the measured length of the wire was 19,416.1 feet. Prof. Nies now travels about in a new "electric."

ELECTRIC CURRENT AT WORK

NEW DEVICES FOR APPLYING ELECTRICITY

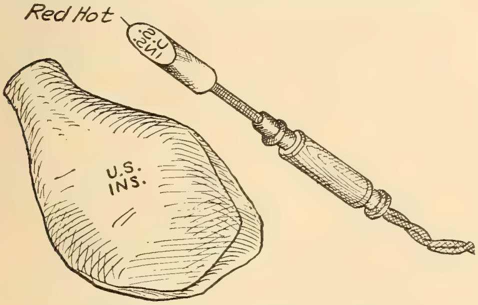
An Electric Milk Jug

The British fondness for hot milk is reflected by the electric milk jugs now offered on the English market in one, two and three pint sizes. They have the heating element in a separable base which can also be used for warming or heating other dishes.

ELECTRIC MILK JUG

Electric Branding Iron

Electricity is even used to stamp the United States imprint on ham and other meat products, designating that they have been approved by the pure food inspector. The Vulcan branding iron by which this is done is made on the principle of an electric soldering iron. It is connected to a convenient lamp socket with a flexible cord. The conductors pass down through the wood handle and terminate in a heating element inside the die. When the current is turned on the die is heated to a red heat.

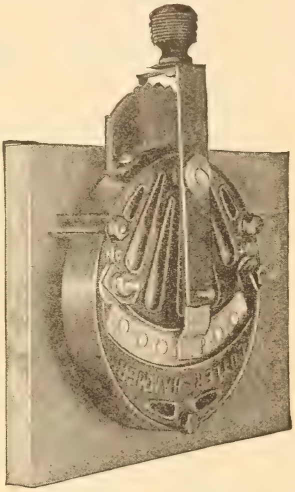

Red Hot
U.S. INS.
U.S. INS.

ELECTRIC BRANDING IRON

Speed-Regulators for Small Motors

A great many people now operate sewing machines, buffers, small blowers, washing machines, jewellers' and dentists' lathes, coffee mills, adding and copying machines, etc., by small electric motors of from one-twentieth to one-sixth horsepower. To use these machines to the best advantage a regulator should be used in connection with the motor so that the speed may be varied.

To meet these requirements a very small but at the same time trustworthy regulator of the Cutler-Hammer type has been developed. It is only six inches in diameter and weighs only 2½ pounds. The operation is by means of a simple sliding lever. Seven contacts are provided giving seven running positions, or these contacts can be arranged to provide one "off" point and six running positions.



REGULATOR FOR SMALL MOTORS

The picture shows one of these regulators provided with a projecting lever or handle which carries a pointer to indicate the position of the contact arm on the buttons below. So arranged it can be mounted underneath a table top, carrying a copying machine for instance, with only the handle and indicator projecting. Then, although the regulator is out of sight and out of the way, the operator, in varying the speed of the machine, can tell by the indicator on what speed the motor is operating.

Sterilizing Liquids by Ultra-Violet Rays

By DR. ALFRED GRADENWITZ

Those rays which in the scale of the prism lie beyond the range of visible light waves are detected only by their chemical effects, especially by the action they exert on photographic plates. Investigations have shown these radiations (termed ultra-violet, that is, beyond violet) to exert harmful effects on living tissues, and especially, to destroy all kinds of minute organisms, such as the microbes.

In view of this behavior it occurred to a French physician, Dr. Billon-Daguerre, that ultra-violet rays could be utilized for the sterilization of liquids, and the experiments conducted by him actually confirmed this prevision.

The first apparatus used by the doctor consisted merely of an exhausted quartz tube (A) Fig. 1, filled with mercury vapor in the interior of which an electric arc could generate those useful radiations. The tube was surrounded by a protective quartz sleeve (B) and an outside brass cover (C). It may be said in this connection that the use of quartz instead of glass is quite imperative, as glass absorbs most of those precious rays. Even air is impervious to them and this is why the vacuum tube arrangement (similar to the well-known mercury lamp) is adopted.

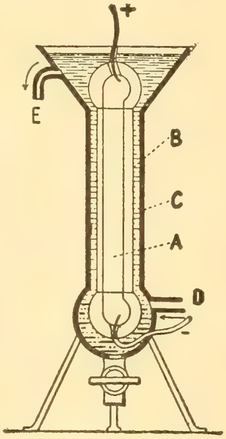


FIG. 1. FIRST APPARATUS OF DR. BILLON-DAGUERRE

After passing into the apparatus the liquid to be sterilized flows in the annular space between the protective sleeve and the brass cover in an extremely thin layer, thus undergoing the sterilizing effects of the ultra-violet rays given off from the lamp.

The next apparatus designed by Dr. Billon-Daguerre, as represented in Fig. 2, consisted of a cylindrical quartz bulb (A) traversed by the current; this likewise formed a mercury lamp. A quartz sleeve (B) soldered to the ends of the lamp insulated the latter from the contact of the liquid to be sterilized, the intermediary space (V) being exhausted. This apparatus was completely immersed into the liquid to be sterilized, and this underwent the action of the lamp without becoming heated, the vacuum (V) constituting an efficient insulation.

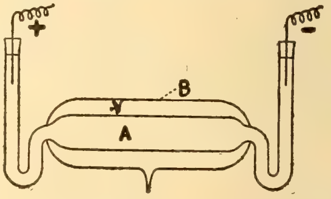


FIG. 2. CYLINDRICAL QUARTZ BULB

In order now to produce a perfect sterilization of the liquid, the latter had to be brought in all its parts into direct contact with the lamp. This is achieved in the apparatus represented in Fig. 3.

A siphon system consisting of a set of bent silver tubes collects the liquid from the outside sleeve (B). The ends of these siphons are so cut as to adapt themselves as far as possible to the curvature of the sleeve, thus allowing the liquid to be collected from the immediate neighborhood of the lamp.

For the sterilization of milk, which is impervious to ultra-violet light, the tubes (T) are given a considerable thickness, Fig. 4, thus causing the liquid to pass in a thin layer between the lamp and the discharging tubes. By increasing the number of these tubes, the volume of the liquid discharged from the apparatus can be increased in proportion. According to the inventor this lamp (which is located in a relatively small glass case) is able to sterilize, with an electrical consumption of only two amperes and 110 volts, 3,600 litres of liquid (wine, beer, milk, etc.,) per hour, while in the case of clear water the output may even be raised to 10,000 litres, a litre being about .26 of a gallon,

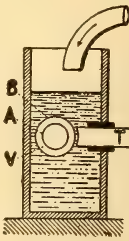


FIG. 3. SIPHON TYPE OF STERILIZER

In spite of these satisfactory results, Dr. Billon-Daguerre unceasingly endeavored to improve his apparatus. The drawback so far experienced was that the effective rays were accompanied by other radiations belonging to the visible part of the spectrum, and which were practically devoid of chemical properties, and accordingly, of any sterilizing effects, serving only to dilute the rays and to reduce the efficiency of the apparatus.

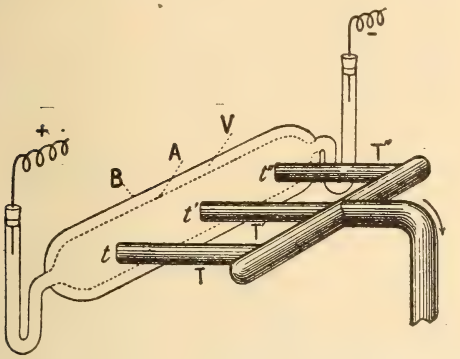


FIG. 4. APPARATUS FOR STERILIZING MILK

This is why the Doctor proceeded to design a lamp able to produce only chemical radiations. Now, by investigating the familiar Crookes and Geissler tubes, containing carbonic acid, hydrogen, sulphide, or other gases, he found the photo-chemical effects exerted by their radiations to be about 25 times more energetic than those obtained with ordinary ultra-violet rays. In fact, the spectrum of those gases showed evidence of radiations of extremely short wave-length (far shorter even than the ultra-violet rays generally used) and which, in view of their situation beyond the ultra-violet, he termed "hyper-ultra-violet" rays.

These radiations were found to possess so extraordinary a microbe-destroying power as to allow of an instantaneous sterilization of the liquids.

It will therefore readily be understood that by substituting for the mercury lamp in the apparatus described above, a Crookes tube of variable shape, the output of the apparatus can be considerably increased, the same effects as above stated being obtained with an incomparably lower electric consumption (two amperes and five to six volts).

It may be said that the sterilizing effects are due exclusively to the radiations, and not to the ozone and oxygenized water generated by their action. In fact sterilization is absolutely instantaneous.

The latest apparatus recently submitted to the French Academy of Sciences (Fig. 5) consists of a quartz tube, 9.8 inches in length, and .79 inch in diameter, containing extremely diluted hydrogen which is traversed by the induced current of a small induction coil, giving sparks .6 inch in length with two amperes and six volts. This minute amount of electrical energy is transformed nearly entirely into invisible rays of extraordinarily short wave-lengths, the chemical action of which is at least 20 times as great as that of mercury vapor lamps.

As the water sterilized by this process is not heated, it remains perfectly fresh, and its taste is not altered in any way. On account of its small dimension and easy handling it can even be used in private houses while on the other hand, its remarkable efficiency makes it quite suitable for use in the very largest installations. In the case of municipal water distribution plants the water is sterilized immediately in the mains, and in order to avoid any breakage, the lamps are located outside of the water conduits, the ultra-violet rays penetrating into the water through two quartz windows.

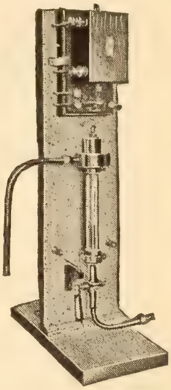


FIG. 5. LATEST FORM OF STERILIZER

Another sterilizing apparatus based on the action of ultra-violet rays has been designed by the Westinghouse Company (limited) and comprises a mercury vapor lamp of the Cooper-Hewitt type, suspended above the surface of the liquid, and which exerts on the micro-organisms in the latter immediate destructive effects without the intermediary of any ozone or oxygenized water.

He Overcame the "Impossible"

Some fifteen years ago a real estate man in looking over a building which came under his care out on Chicago's West Side found in charge a young lad who performed the numerous duties of elevator boy, engineer, etc. The boy's knowledge of things, his confidence in himself and his great desire to know something of electricity led the real estate man to install a private lighting plant in the building. Entrusted to the lad's care, it never wanted for attention, and it was a friendship thus begun between Perkins B. Bass and Austin Kimble that helped lead to the invention and manufacture of a motor that, to those who have made a study of electricity, does seemingly impossible things.

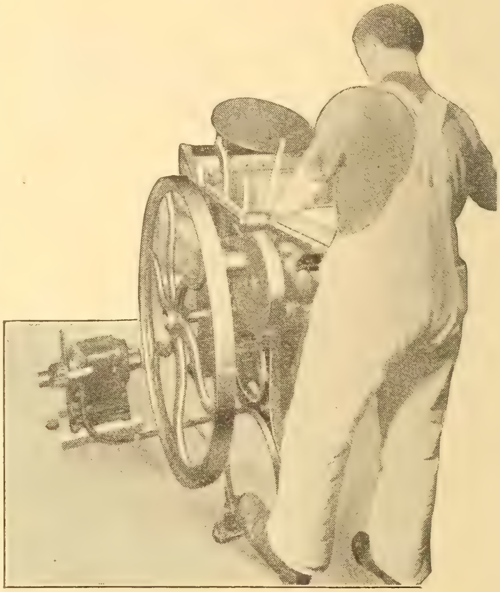
But the story of the man who thought it out is full of interest. Upon the advice of his friend he took up a correspondence course in electricity and it was not long before he was told as a result of his investigating turn of mind that an alternating current variable speed motor was an impossibility without using a wasteful resistance, controller or rheostat with it.

"Well, I'll build one then," he replied, for it was always the seemingly impossible things that Kimble thought worth trying out, his queries in this line often causing his electrical associates to smile. As the first step to change the meaning of these smiles, a shop not more than fourteen feet square was set up in a barn, with his wife as first assistant, and an old automobile engine to furnish power to a lathe. His first motor armature was mounted on a broom stick for a shaft, but demonstrated that he was on the right track. Fitted with a steel shaft, it was sold, but for less than it cost. Another motor was built and sold, and then others followed.

Mrs. Kimble advanced from helper to armature winder, then bookkeeper. Business grew. The lad of yesterday was coming on, but by hard work. He had accomplished one thing thought "impossible." He frequently slept on a cot in the shop during these years for two reasons: To save time going to an from work and to work out new problems that came to his mind whether during night or day; for Austin Kimble thought best at night and often would get up at two or three o'clock in the morning to try out in the shop some new idea that came to his mind.

Finally the little shop was abandoned for a larger place, and then for a second time business forced expansion and yet the third and fourth time, to the present factory location which the visitor can see will not long provide sufficient room.

Kimble's single phase alternating current motor operates off single, or any phase of two or three-phase circuits. Without a controller or resistance the motor starts, runs at *any* speed from 300 up to 3,000 revolutions per minute, may be reversed while at full speed by throwing a single lever from one extreme point to the other, or stopped by placing at mid-position this lever which merely shifts the brushes.



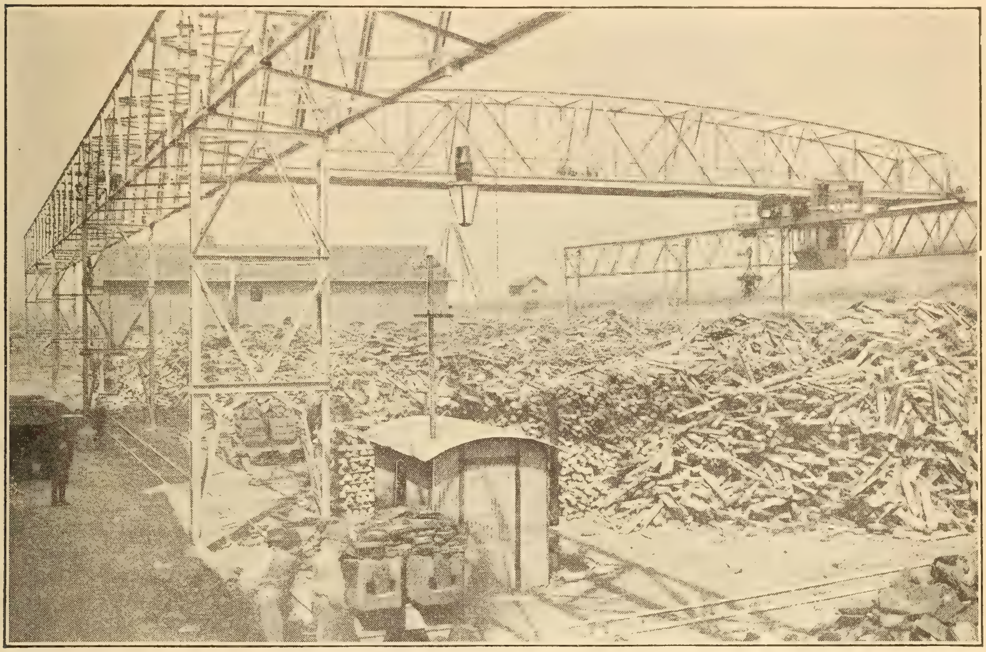
VARIABLE SPEED ALTERNATING CURRENT MOTOR DRIVING A PRINTING PRESS

Electrical engineers and professors are incredulous until they see the motor doing these things. Further and unlike other motors the current, speed and power all increase or decrease together. There is no surge of current to blow fuses when starting the motor.

Built in sizes of from $\frac{1}{8}$ to ten horsepower the motor has solved the problem of economy and variable speed regulation where alternating current is available. The illustration shows a motor operating a printing press, the operator having complete control by a foot lever.

The World's Greatest Pig Yard

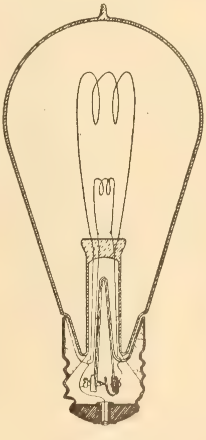
Where is the world's largest pig yard? Most men will answer Chicago, Omaha, or Kansas City, thinking of the immense stock yards at each place. But by actual count the larger stocks of pigs are found far from the packing industries, for in certain industries the word pig means something quite different from the porker of our barnyards or the guinea among our household pets. In the iron and steel trades the word pig denotes the slab or stick form into which iron is first poured when it comes from the blast furnace. To avoid being caught short of their supply of such raw material in case of railroad troubles, most users like to carry a huge stock of these pigs on hand. Formerly they were handicapped in this by the long time it took the laborers to unload and afterwards to cart the heavy bars. Now this work is made easy by an electro-magnet. on a traveling crane which picks up ten to 20 of the pigs at a time and holds them until the current is turned off. With the handling of the pigs thus simplified, the yards used for storing them have grown to immense proportions, like the one of which our cut shows only a part, this being a German pig yard.



ELECTRO-MAGNET HANDLING PIG IRON

Lamp and Flasher Combined

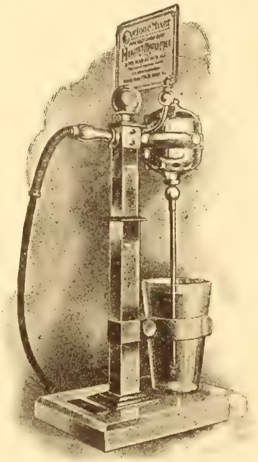
An incandescent lamp having two different candle-power filaments and with a make and break thermostat for flashing them contained in the neck or screw shell of the lamp is described in a patent issued to William J. Phelps, Detroit, Michigan. A bent bar thermostat of two metals such as brass or steel closes the circuit through the high power filament. The current heating the thermostat opens the circuit as the bent metals expand, placing the long filament as a resistance in series with the low power short filament. As the latter has a greater resistance per unit length than the long filament the short filament lights up. The thermostat now carrying no current, cools and again closes the circuit through the high power filament.



LAMP AND FLASHER COMBINED

Electric Drink Mixer

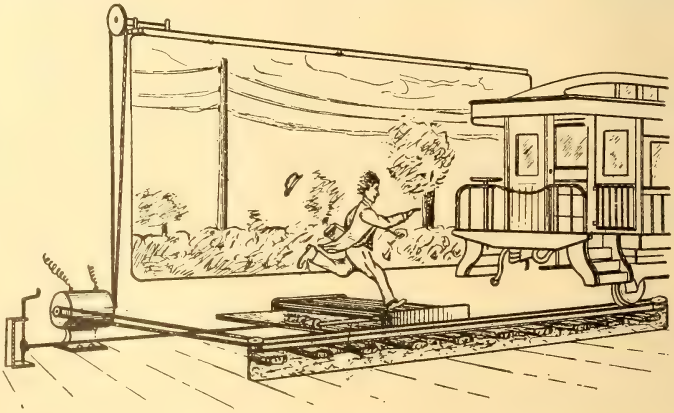
Ever quaff an "electric milk shake?" It's delicious, and in this age of things electrical will surely become popular. The "O-See-Us" drink mixer runs by electricity and consists of a little motor mounted on a suitable stand. Direct connected to the motor is a vertical shaft on the lower end of which is a large thick button. Running at high speed the button will mix thoroughly any drink that you now shake or stir. All flavors are perfectly blended and the customer gets a more satisfying drink in less time than by the old "armstrong" method.



ELECTRIC DRINK MIXER

Producing a Stage Illusion

To cover an invention for producing illusory effects on the stage, a patent has been granted to TimothyR. Barrett, Bordentown, New Jersey. The arrangement provides means for showing a person vainly endeavoring to catch a train, boat or other conveyance. In the back ground is an endless curtain upon which is painted a panoramic view of scenes along the route of the conveyance. At the front of the stage is a narrow endless curtain painted to represent the ties and rails of the railroad track as in the illustration, the wheel of the coach being turned by contact with the edge of this curtain. Between the two curtains a moving sidewalk operates fast enough to enable the actor to produce a good imitation of a frantic attempt to catch a departing train. Both curtains move at the same rate of speed operated by an electric motor.

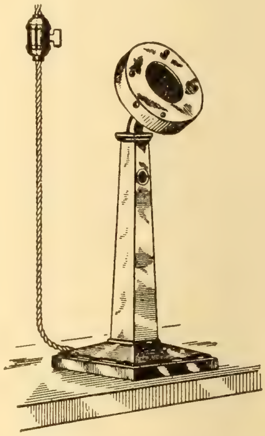


STAGE ILLUSION

Cigar Lighter

This device is not a telephone but a cigar lighter. The cross-wire within the transmitter-like opening is a resistance wire bent back and forth to afford plenty of hot wire against which to place a cigar to be lighted.

Platinum wire which is often used in lighters is expensive and breakable. It is the object of this invention to so construct a cigar lighter that the current can be transformed or stepped down to a lower voltage and increased amperage, enabling the use of a much coarser and stronger wire, of a much less expensive material which will offer a greater heating surface, and will come to the glowing point in the shortest possible space of time. A small step-down transformer is therefore enclosed in the body, the current being turned on by pressing the push button. A patent on the device has been issued to Victor E. Extrom and Thomas G. Boardman of Tomahawk, Wisconsin.

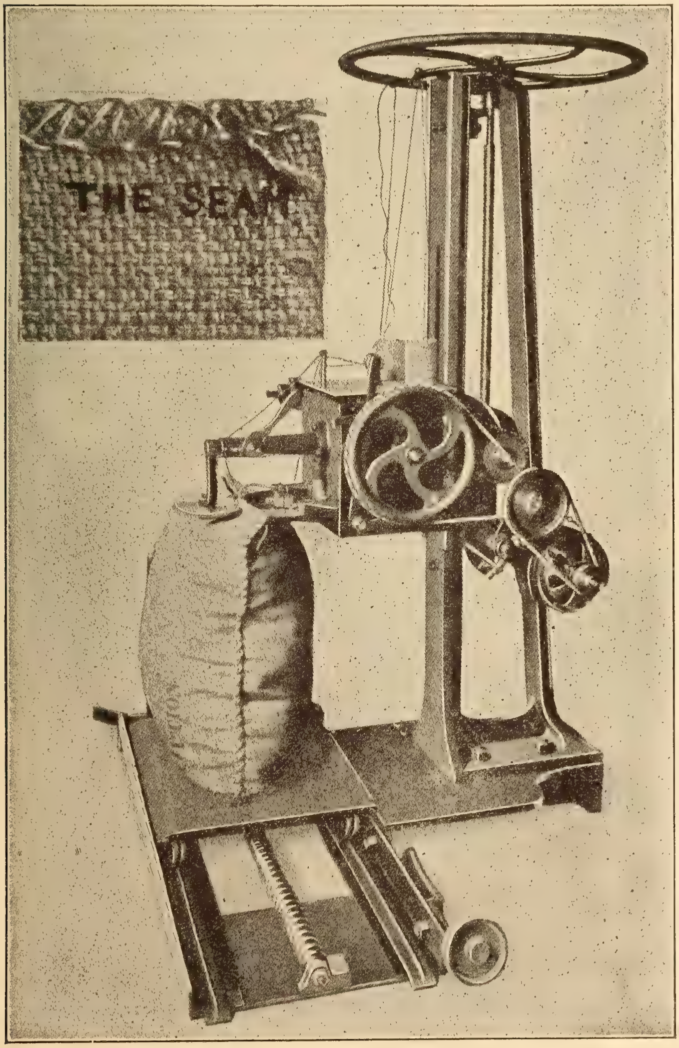


CIGAR LIGHTER

Sewing Up Grain Bags

A bag stitching machine invented in Germany by A. von Hasperg, actually sews up the mouth of a filled bag. The bag itself is placed on a little wheeled cart which is automatically moved past the needle after each stitch, the sewing mechanism being easily moved up or down to match the height of each bag. The machine sews a peculiar seam of interlocking stitches which it tangles at the end of its run so that no hand knotting is required, but which can be quickly unraveled after cutting one of the thread loops at the right end. A quarter horsepower electric motor does the work.

The peculiar stitch produced by this machine cannot readily be duplicated by hand, hence bags closed in this way will show at a glance if there has been any tampering with their contents in transit.



GRAIN BAG STITCHER AND SOME OF ITS WORK

Making Blue Prints From the Original Drawing

In making blue prints it is necessary that the drawing be made on transparent material. As ordinary drawing paper is practically opaque, a tracing must be made from the original on transparent tracing cloth. Obviously, therefore, if the original drawing could be made transparent by some process, so as to be used in blue printing, one time-consuming step would be saved. This might be done with inflammable liquids, such as gasoline, but there would be great danger of burning up the drawing, especially if an arc light were used in printing.

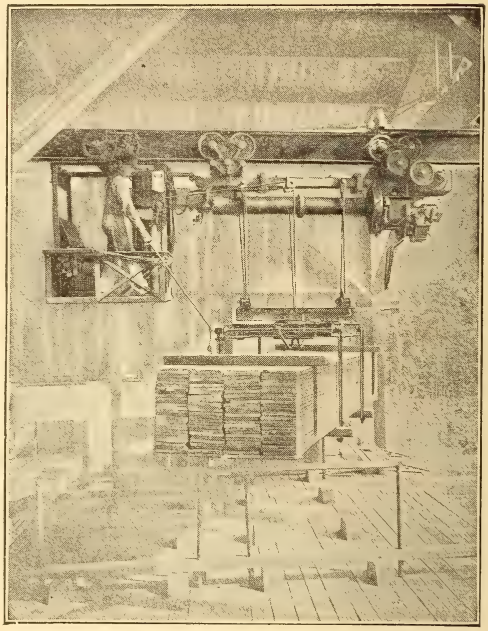
If the sheet could be drawn through some safely handled liquid which would make it transparent and then dried, we could get the needed transparency in less time than it takes to tell about it.

Carrying out this principle, a New York firm has brought out a "Mechanigraph" in which the drawing is passed between rollers into an electrically heated liquid and then carried by moving tapes over the drying rollers which are also heated by the same current. All the operator has to do is to start the paper between the rolls and to turn a crank just as if he were using a clothes wringer. The liquid used is said to be non-inflammable and to cost only a third of a cent per square yard of the paper treated; and as the current is used only for short periods, its cost would be more than covered by the saving in tracing cloth. The space occupied by the apparatus is less than would be needed by a single draftsman, though a single such device may replace scores of tracers, thus increasing the capacity of the draughting room.

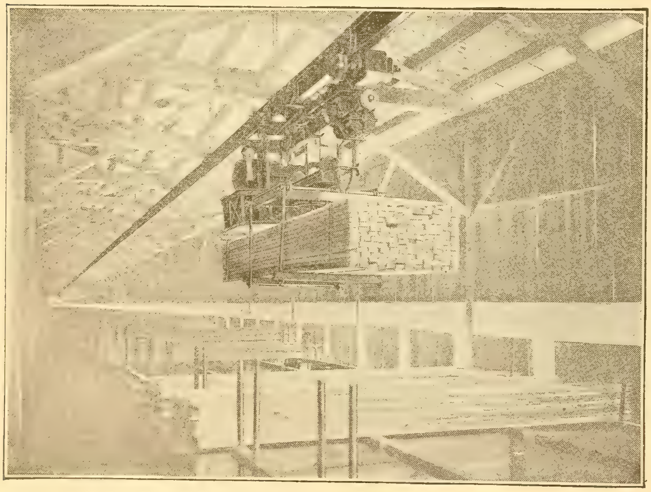
Monorail for Handling Lumber

Not very far back the lumber as it was produced in the mill was handled and stored by hand labor and with teams to cart it from one shed to another. Now, in many instances an electric monorail system whisks the lumber about with incredible rapidity and at a great saving in labor expense.

The tracks of the system are steel I-beams hung high above the floor level. Suspended therefrom on wheeled carriages are a cage for the operator, a winding drum for lifting a sheaf of lumber and the motor for doing the lifting and propelling. The lumber is piled, to begin with, on cross bars. The monorail car is then run over the lumber and a set of tongs lowered away until they can be hooked under the ends of the cross pieces. Then the load is raised and carried away over the track to the particular tier on which it is to be placed, all these operations being controlled to a nicety by the man in the cage.



RAISING A LOAD AND GETTING READY TO NEGOTIATE A TURN



A LOAD UNDER WAY IN THE SORTER SHED

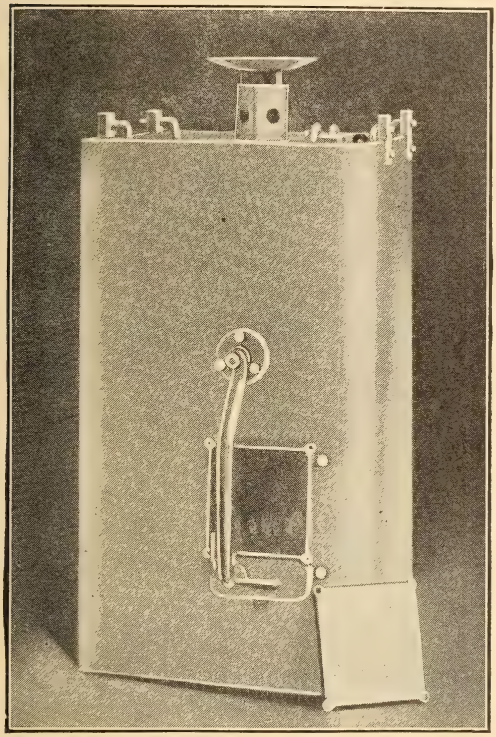
Automatic Fire Extinguisher and Alarm

A German inventor has developed a new device which is at once a fire alarm and fire extinguisher. It consists of a carbonic acid generator to be placed in the room to be protected. It operates in connection with a thermostat which closes the circuit to the alarm and generator when the temperature of the room gets above the danger point.

When the thermostat makes electrical contact, by an excessive temperature a pawl is disengaged by the armature of an electro-magnet in a small chamber on the outside of a fire extinguisher. This releases a lever which causes a small tank containing sulphuric acid within the extinguisher, to tilt by its overweight, the acid flowing out through small holes into a solution of potash contained in the outer vessel.

Instantly large volumes of carbonic acid gas are produced by the mixture of the acid and potash solution, from 5,000 to 15,000 liters of this gas being produced within 30 seconds, according to the size of the extinguisher, and thrown into the room by a surplus pressure varying up to one atmosphere. As is well known combustion cannot take place in an atmosphere of carbonic acid gas, so the fire is extinguished.

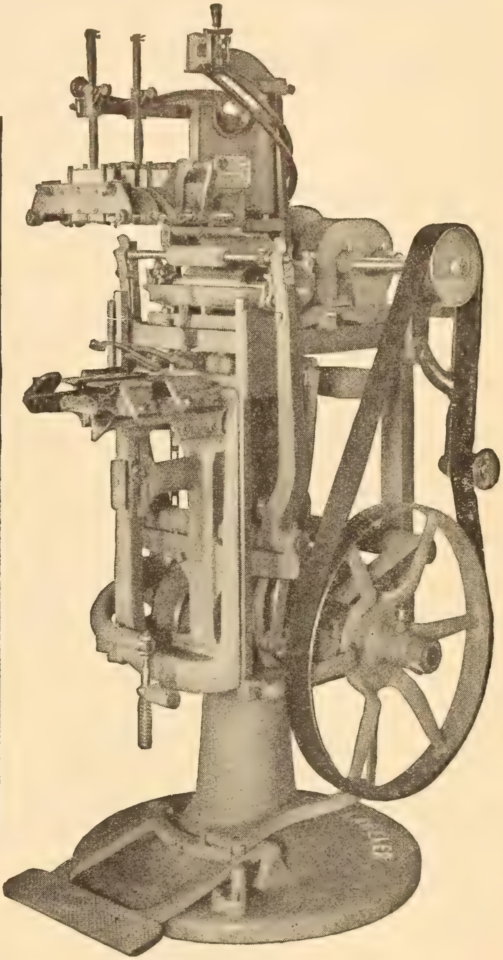
At the same time an electric fire alarm circuit is closed giving the alarm at any distant point desired. Then, if the carbonic acid gas has not completed its work other means may be employed to put out the fire.



AUTOMATIC FIRE EXTINGUISHER AND ALARM

Machine Puts Labels on Bottles

The next time you pick up a bottle containing wine, a vegetable sauce or something else, just notice the paper labels on it. There is probably one around the body and another on the neck of the bottle, and although these labels are in many cases put on by hand yet a machine which will do all this automatically in one operation is here shown. The Economic Labeler does what might seem impossible to the casual observer for it will handle round, square, hexagon, oval or flat bottles, gluing the entire surface of the label to the bottle, or simply the edges of the label as desired. Cams, rolls and prongs all acting as if alive take the labels from a holder on the machine in which 1,000 may be placed, put on the glue and finish the job with accuracy and speed. An electric motor furnishes the power.



MACHINE FOR PUTTING LABELS ON BOTTLES

Edward C. Pond of Petersburg, Va., has patented a device for photographing the dials of electric meters, thus giving the meter reader an infallible record of his work.

FOR PRACTICAL ELECTRICAL WORKERS

HOW TO MAKE AND OPERATE ELECTRICAL DEVICES

Sign Board to Facilitate Ticket Selling

By **THERON P. FOOTE**

The theatre box-office man has his troubles.

"Two tickets near the front, please," calls a patron. The box-office man hands him E-5 and 6.

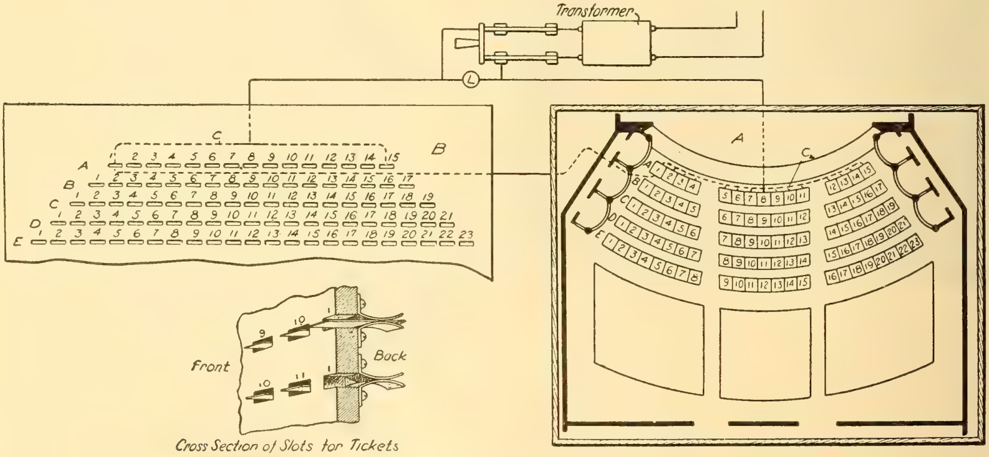
"Oh, No!" objects the buyer, "I want something near the front." E-5 and 6 are put back and B-2 and 3 offered.

"Are those on the aisle?" Again the tickets are exchanged for B-4 and 5.

"How much?"

"Two dollars."

"Oh! I thought they were 75 cents each," is the response.



SIGN BOARD TO FACILITATE TICKET SELLING

"No, rows A to E are one dollar, E to N, 75 cents."

"Well, then give me two seats in E on the aisle if possible," and during all this time others are waiting perhaps to hear the same thing by the next in line.

The device here illustrated would do away with the annoyances noted, enabling a theatre-goer to know at a glance what seats are not sold, take his choice and put down his money with "Give me B-4 and 5."

The general arrangement for the equipment is as follows: In the vestibule of the theatre may be placed a board (A) about ½ inch thick and large enough to contain a full chart of the seats in the theatre, allowing a ½-inch square for each seat. After locating the seats by squares, ¼-candlepower lamps are set in the board by drilling a ⅜-inch hole in each square to a depth of ⅜ inch, and then a ¼-inch hole the rest of the way through. Miniature sign receptacles may be set in these holes. A common wire (C2) is now connected to one side of all of these receptacles in which small lamps are placed, this common wire being connected to one side of the transformer as shown. From the other side of each lamp a wire is run into the ticket office and connected to the lower of two brass spring clips shown in the detail drawing which is a cross-section through (B).

In the board (B) which may be about ½ inch in thickness are cut slots 1-16 inch wide and 1-16 inch longer than a ticket is wide each slot representing a seat on the chart in the vestibule. On the back of board (B) which may be mounted out from the wall on brackets the spring clips are mounted as shown in the detail, one above the slot, the other below. The brass pieces make contact when in position but when a ticket is inserted from the front they are sprung apart and thus serve as a switch. Each upper clip is connected to a common wire (C), as at A-1, and this common wire runs to the transformer.

After low voltage lamps have been placed in the receptacles of the vestibule board a frame containing glass frosted on the inside is mounted in front of the lamps and with black oil paint a chart of the seats drawn on the glass and numbered as in the theatre and on the ticket board of the box office.

When the tickets are all in the slots of the board (B) the lights are all out, but as soon as a seat is sold the ticket is pulled from the slot, allowing the brass clips to make contact and light the lamp under that seat in the vestibule chart.

From the seats over the unlighted lamps the purchaser makes his selection, before he gets to the window. He then tells the location by number, pays the price, and makes way for the next. The glass may also contain the scale of prices for seats in different parts of the house, thus enabling the patron to know this when making his choice.

A step-down transformer which lowers the voltage to ten volts will simplify the wiring requirements and reduce the cost of current by using low-voltage low candlepower lamps.

Practical Don'ts for the Electrician

Don't wire a building and leave the wires sagging.

Don't use fuses that are not enclosed.

Don't put a pulling strain on a lamp cord.

Don't use the edge of a knife to clean a wire.

Don't allow the switchboard to get out of repair.

Don't leave the conduit pipe ungrounded.

Don't use an unnecessary amount of wire and tape to do the job.

Don't place the fuse plugs in such position that water can get to them.

Don't use emery paper on a commutator; it will soon ruin it.

Don't leave a joint without soldering it.

Don't throw a switch lever in and out too slowly.

Don't forget that mica is one of the best insulators.

Don't put up rosettes without their proper fuses.

Don't use dry cells where a constant current is desired and expect to get the best of results.

Don't allow dirt and grease to come in contact with the switchboard or rheostat.

Don't attempt to switch the brushes while the motor is running at full speed.

Don't place the hands about the generator when it is not necessary.

Don't forget that electricity is an unseen force and keep your mind on your work.

Don't use a screw-driver or pliers unless the handles are well insulated. Many a life has been hurled into Eternity because of this.

Don't put in a new brush without first fitting it to the commutator.

Don't start a new motor without first making a close examination of it.

Don't put wires crossways without first putting bushings between them.

Don't leave a key in a socket and expect no one to tamper with it.

Don't overload a circuit beyond the carrying capacity of the conductors used.

Don't use anything but fuses that are authorized by authority.

Don't work around the generator with your pockets crammed full of steel tools, as it is dangerous.

Don't sweep the floor and clean while the generator is running, as the dust that settles on the generator will be very injurious to it.

Don't solder a joint close up to the wall or woodwork, without first placing next to it a sheet of asbestos.

Don't forget that a generator should have a good blowing out with a strong blast of air occasionally.

Don't wind a large wad of tape over a joint after splicing, for a splice should be covered with just enough tape to make the splice the same size as the original insulated wire.

Don't forget that pure coin silver makes a very good emergency contact point.

Don't throw a rheostat lever too quickly but give a little time.

Don't put two solid carbons, or two cored carbons in an alternating arc lamp.

Don't throw a switch before you know a connection has been made.

Don't splice a small line and a large one together.

Don't enclose a generator in a place where it cannot get air.

Don't try to make a splice without first cleaning the wires.

Don't use acid in soldering a wire.

Don't fail to place the switches in places that will be handy to get at in case of fire.

Don't put a generator or a motor on a shaky foundation.

Don't disconnect a number of wires without tagging them, as some one else may have trouble in finding the proper connection.

Don't attempt to trim an arc lamp while the current is on, turn it off.

Don't overload the motor or generator for a very long time, as it will be very injurious to the machine.

Don't leave loose bolts, nuts, tools, etc., around the generator, for they are liable to get into the machine and something serious might happen.

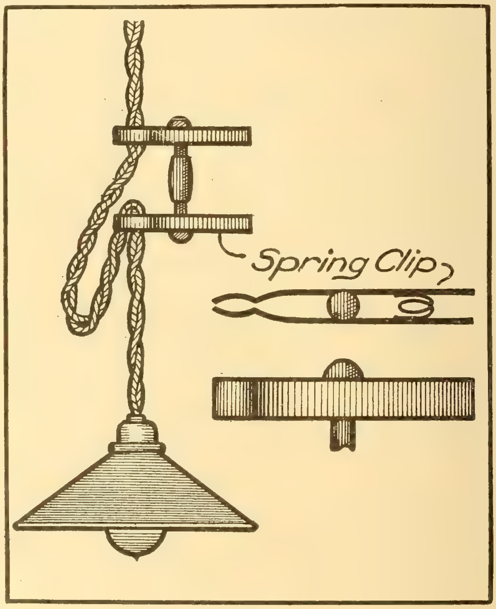
Don't allow visitors to wander about among the belts and machines. They are not aware of what could or might happen to them.

Removing Oil From Water

One of the most persistent problems confronting the steam engineer has been that of removing the oil from the condensed steam which is obtained when using steam engines. This condensed steam, in the form of very hot water, is economical to use over again in the boilers if the oil can be taken out of it. The engines must have the oil to lubricate them, hence it is partly diffused through the steam and unless it is separated from the latter after this is condensed into water, the oil may be troublesome in the boiler. Mechanical devices, as used to effect this separation, have so far succeeded only in removing about three quarters of the oil, but a new electrolytic method is much more efficient. This works on the principle of forming a basic salt in the water through the action of an electric current and when this salt sinks to the bottom of the electrolytic tank, it carries most of the oil with it. Tests recently made with this new Davis-Perrett process are said to have shown that 98.5 per cent of the oil was thus separated from the water, and that at the remarkably low cost of only three cents per 100,000 gallons of water.

Spring Clip Cord Adjuster

A convenient lamp cord adjuster has been patented by John Maitland of Lynn, Mass. The drawing explains the principle, which is very simple. Two spring clips, working somewhat on the plan of a spring clothespin, grip the cord at two points and are held together by a short connecting member. As much or as little slack as desired may be included between the two clips in order to adjust the position of the lamp to the particular height desired.



SPRING CLIP CORD ADJUSTER

Pressure of a Church-organ Bellows

In the side view, Fig. 1, is shown a one-half horsepower, single phase, back-geared electric motor pumping an old church-organ bellows of the reciprocating type. As an automatic speed regulator cannot well be used in connection with this current the homemade mechanism as described below was devised to govern the air pressure. Being fixed at the proper distance above the bellows it is operated by the action of the bellows itself.

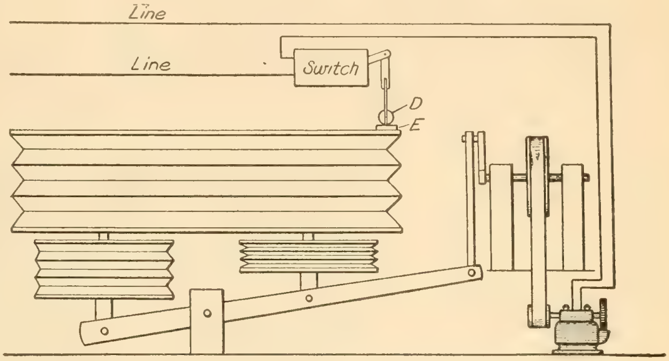


FIG. 1. MOTOR DRIVING CHURCH ORGAN BELLOWS

The slide, (shown in detail at (S) Fig. 2) made of ¼ inch hard fibre, is readily adjusted to break the motor circuit at any desired fullness of the bellows. Any convenient number of holes for the removable pins may be used in both parts.

In Fig. 2 (A) is a knife blade switch terminal with spring washer under screw-head and carries the copper blade (B) which may be of any required length.

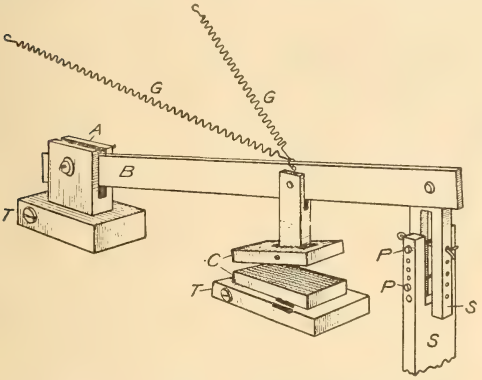


FIG. 2. DEVICE FOR MAKING AND BREAKING MOTOR CIRCUIT

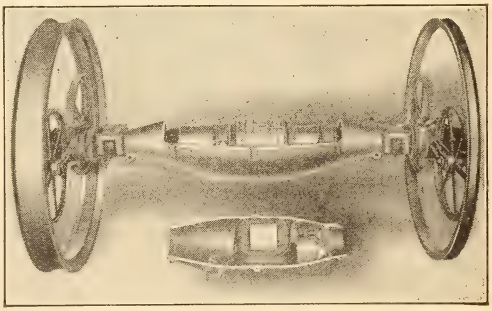
As the current is interrupted quite frequently when the motor is in operation, carbon blocks (C C) are used to insure a continued smooth surface and good contact.

The iron ball from an old two-ball cord adjuster answers admirably for a weight (D). The spiral springs (G) are of sufficient tension and so situated as to make a quick break before the upward pressure of the bellows separates the carbons. It will be noted that the upper carbon is not quite centrally pivoted, thus keeping one end in contact until springs (G) operate. The pull of these springs is nearly parallel with blade (B), when the circuit is closed and cannot act until the blade is slightly raised.

The play between pins (PP) allows the bellows to rise until the lower pin (P), with the later assistance of springs (G), trip the switch and stop the motor. Due, now, to the fall of the bellows the weight (D) finally closes the circuit again, the upper pin (P) coming into play.

Hollow Axle with Motor

An unusual form of gearing for driving an automobile is represented by the Walker balance drive. The armature of the electric motor is mounted directly on the axle of the vehicle. As the armature turns the axle must turn with it. Then, on each end of the axle is a small pinion driving two larger gear wheels which in turn transmit the power to an annular gear on the inside of the wheel rim. The entire axle and motor are enclosed.

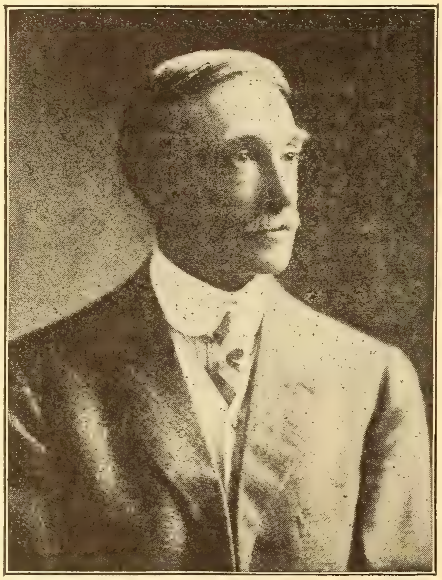


MOTOR ENCLOSED IN THE AXLE

Electrical Men of the Times

ELMER A. SPERRY

One of the pioneers in modern electrical development is Mr. Elmer A. Sperry, now of New York City. He was born at Cortland, New York, on the 12th of October, 1860. After eleven years at the State Normal and Training School, Cortland, he studied at Cornell, beginning with a special course of lectures in 1879 under Dr. William A. Anthony, Professor John E. Sweet, Professor Moler and others of this period. This was the first electrical course of study in America.



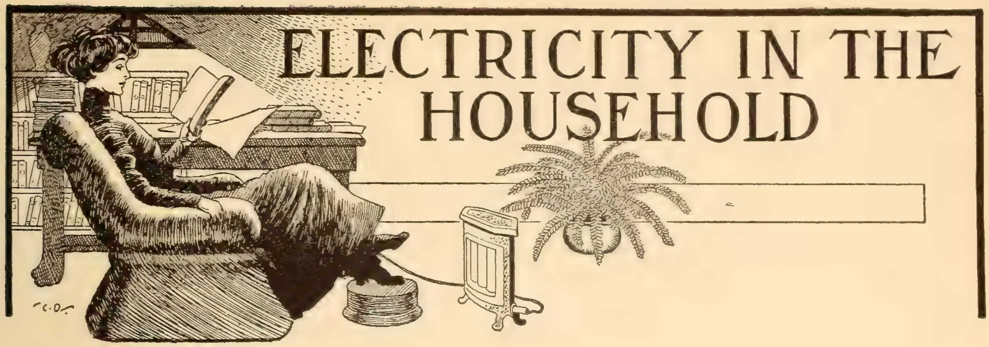
On graduation he started a manufacturing concern of his own in Chicago, in the latter part of 1880, namely, the Sperry Electric Company, which made arc light dynamos, lamps and motors. He also became later engineer of the Standard Electric Company, the Sperry Electric Mining Machine Company, the Link-Belt Machinery Company of Chicago, the Sperry Engineering Company and the Sperry Electric Railway Company of Cleveland, Ohio.

In 1883 he started, and for some years operated the first central station for electrical supply in Chicago; lighted the Chicago Tribune Building, Marshall Field's, etc. This was later consolidated with the Arc Light and Power Company and finally absorbed by the Chicago Edison Company.

In the early '80s Mr. Sperry began constructing electric mining machinery, the concern becoming the Sperry Electric Mining Machine Company. This was the pioneer in this line of work, which is now being carried on by its successor, the Goodman Manufacturing Company of Chicago. About this time he also perfected a system of electric traction in which field much pioneer work was done. He has also done much research work in connection with internal combustion engines, especially of the compound type, one of these engines reaching the thermal efficiency of over 40 per cent as measured at the brake.

Mr. Sperry was one of the founders of the American Institute of Electrical Engineers, before which body he has presented a number of papers. He also was one of the founders and organizers of the National Electric Light Association, being active in the early years of the history of this institution, and having been chairman of the Committee of Call of the first convention. He has read papers and presented discussions before this body and at the twenty-fifth anniversary at St. Louis, in May, 1910, read an interesting account of the creation of the Association in 1885. In addition to this, he was one of the founders of the American Electro-Chemical Society and has presented papers before that body.

Among other things, Mr. Sperry developed the Townsend electrolytic cell which now forms the basis of the largest producer of alkaline and bleach in this country; the factory is located at Niagara Falls. He has for many years been engaged on original research work in connection with practical applications of the gyroscope; and has delivered a number of illustrated lectures on this subject. He has been working with the United States Navy in the development of the larger engineering type of gyroscopic apparatus for steadying ships and also for battle and marine compasses, and "gyros" for steadying aeroplanes. Mr. Sperry is now engaged as a general consulting engineer in New York.



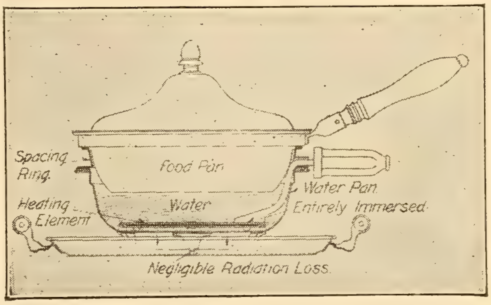
ELECTRICITY IN THE HOUSEHOLD

Alcohol Chafing Dish Changed to Electric

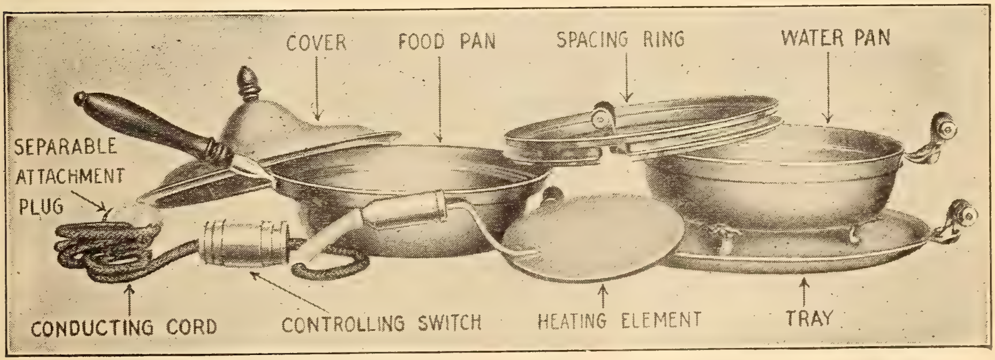
In accordance with a law well known to electrical engineers the efficiency of the heating element which is a part of your electric chafing dish, coffee percolator or any other electrically heated device of similar nature cannot be increased. As far as actually turning the energy of the current into heat is concerned one is as efficient as another. The problem, then, is to apply the heat from this element in such a manner that none of it will be lost.

In a new type of Westinghouse chafing dish the manufacturer claims certain advantages in the above respect. The new chafing dish, the parts of which are shown in the "exploded view," consists of an ordinary chafing dish to which is added a disk type heater and a spacing ring to provide for its admission. This heater somewhat resembles a stove lid with handle permanently attached. The electrical conductors to the heating element are carried up through the handle, called the lead arm.

A glance at the sectional view shows how the parts go together. You first place the necessary amount of water in the water pan and then suspend the heater in the water. Next put on the food pan. The whole outfit may be bought complete, or, if you have an old chafing dish of the alcohol type, having an outside diameter of water pan of $8\frac{3}{4}$ to $9\frac{3}{8}$ inches, it may be converted into an electric by the use of the spacing ring



CROSS SECTION OF NEW CHAFING DISH



"EXPLODED" VIEW OF NEW CHAFING DISH

alluded to. The spacing ring and heater may be obtained separately for this purpose.

The claim for increased efficiency is based on the fact that, as you will notice, the heater element is entirely surrounded by water instead of the under side being exposed to the air at the bottom of the dish, as in some other types. Therefore all the heat from the heating element must enter the water, which does the cooking.

Where Art and Science Meet

By T. VERNETTE MORSE

There are two classes of women who entertain. The one, who, with plenty of servants at her command, gives her orders, calls in the extra "help" that is necessary, invites the guests that belong to her "set," provides plenty of amusement, and is in every respect a queen among the social leaders.

Frequently she is the envy of her near-by neighbors, whose means do not admit of such expenditures, although they instinctively long for the same privileges under the same conditions.

For some reason the woman who entertains in this conventional manner does not, as a rule, give her guest half as much pleasure as the resourceful woman, who never lacks for ideas that are at once novel and interesting.

Friends of the latter soon learn that she has the ability to give them pleasure, and her invitations are looked forward to with delight.

The rooms may be small and plainly furnished, but they are always comfortable and homelike, only a few friends are invited at a time, consequently there is no crowding. Every hostess is, or should be, a law unto herself, giving of her hospitality for friendship's sake.

With electricity in the house, many novel results may be obtained. For a company luncheon why not bring into use the electrical percolator, chafing dish and toaster? Invite some friends to assist and let each one of them prepare a favorite dish. There is always good cheer where every one is busy, and the general air of preparation finds an interesting echo in the hearts of the guests, who will no doubt catch the spirit of the occasion and thereafter combine in groups for the purpose of entertaining. At such a gathering there is a feeling of good fellowship that is often lacking in more formal occasions, and all will go so merrily that the hostess and her friends actually forget the cares and anxiety of life in the enjoyment of gracious hospitality.

The housewife who understands the artistic arrangement of the table will make a simple repast appear like a banquet. Snowy white linen, fresh flowers and bright silver properly arranged are the first requisites.

For the conventional or formal luncheon the polished table with individual embroidered doilies is generally used, although a luncheon cloth covering the table is always in good taste. The menus for use in serving from the electrical appliances may be varied, as there is plenty of heat for the cooking, and by the use of a side table the extra dishes may be removed without confusion. For hot water there is nothing to equal the convenient glass globe electric heater which is ornamental as well as useful.

Excellent company luncheons may be served from the following attractive menus which may be varied and enlarged to suit the occasion:

MENU NUMBER ONE

Cream of tomato soup
Creamed chicken in patty shells
Rice croquettes Jelly
Celery salad
Ice cream Cake
Coffee demi tasse

Cream of Tomato Soup.—Place one can of tomatoes in the stew pan and cook slowly for half an hour, add one-fourth teaspoon soda, rub through strainer. Make a white sauce of one quart milk, one teaspoon butter, $\frac{1}{3}$ cup flour, $\frac{1}{2}$ teaspoon pepper, salt to taste. When sauce is thoroughly cooked add tomatoes and serve immediately.

Creamed Chicken.—Two cups cold diced chicken, $\frac{1}{8}$ teaspoon celery salt, a few drops of onion juice. Make a cream sauce of two tablespoons of butter heated in the chafing dish. Add two tablespoons of flour, salt, pepper, add one cup of thin cream. When the sauce is cooked add chicken and heat through. Serve in patty shells.

Celery Salad.—Cut the celery into fine pieces; add half as much chopped apple as celery. Serve on lettuce leaf with mayonnaise dressing.

MENU NUMBER TWO
Consomme soup
Creamed sweetbreads with mushrooms
served on toast
Saratoga potatoes
Fruit salad
Orange ice Lady fingers
Chocolate

MENU NUMBER THREE
Clear soup with salted wafers
Chicken croquets with creamed peas
Medley salad Toasted crackers
Charlotte russe Bananas in jelly
Coffee with whipped cream

MENU NUMBER FOUR
Beef tea
Escalloped oysters
Nutlet sandwiches Waldorf salad
Chocolate cream Mixed cakes
Coffee with cream

A little practice in arranging a neat family luncheon will soon enable one to extend the courtesy to a small company without the slightest confusion.

Electric lights hidden in the foliage of plants is an attractive feature in decoration.

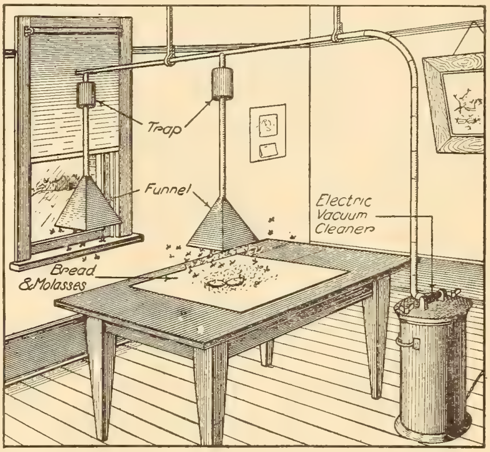
The woman who is able to overcome her inclination to follow "style" blindly, who cultivates her good taste through the proper application of her life to the conditions by which she is surrounded, who is kind and gracious to the faults as well as the good qualities of others, need have no fear as to the result of her entertainments, for they will reflect her own character and receive the grateful acknowledgement of her friends.

No Sweeping, No Dusting

There is no more reason why a woman should have to sweep and dust than there is why she should have to cook over a fireplace. Sweeping and dusting are signs of a time that should be past. Such methods of cleaning were all right when better methods were unknown. Vacuum cleaning is a better method. A vacuum cleaner gets all the dust and makes none—so there is no dusting and electricity does most of the work. The little work that a woman does is not burdensome. The air she breathes while cleaning is clean. No dust settles in her hair. When her task is finished, she is not in need of a bath. And, if she has been running the cleaner for an hour the cost of the electricity consumed is less than three cents.

Vacuum Fly Trap

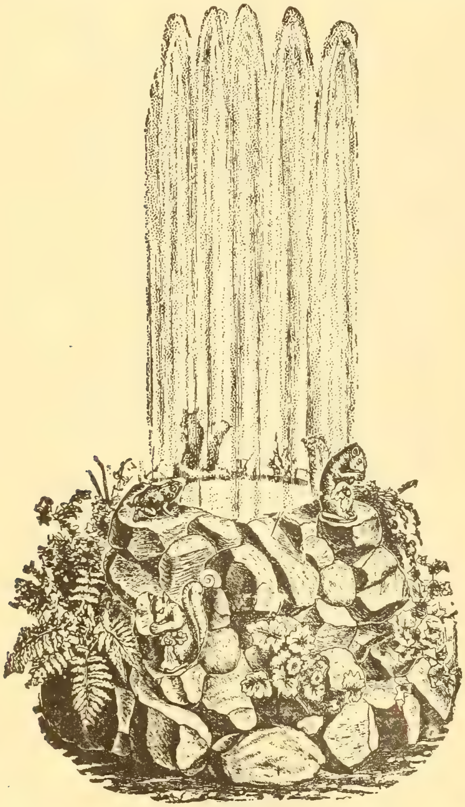
A great campaign is now on, fostered by the United States Government and the health departments of various cities, against flies as carriers of disease germs. In line with this movement a Colorado housekeeper has made novel use of an electric vacuum as a fly trap. As shown in the drawing, a series of funnels are hung at the windows, over tables, or wherever flies are apt to buzz about. The moment a fly gets close to a funnel the suction overcomes its wing power and it is drawn up into the fly trap, never to return. This trap has a valve which closes the suction tube when the vacuum motor is shut down, otherwise the flies might trace their way back to freedom. At convenient times the trap portion is taken off and immersed in hot water to kill the flies. If preferred the flies may be chloroformed. An interesting line of investigation would be to ascertain how many flies per kilowatt-hour of electric energy can be handled in this manner.



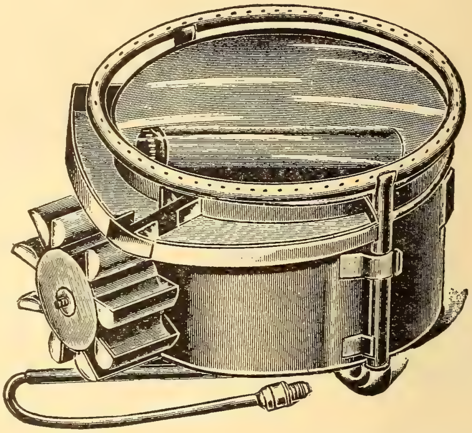
CURIOUS VACUUM FLY TRAP

Small Color Changing Fountain

An artistic electric fountain of small size, so as to be suitable for the home, is the product of a Boston firm. Unlike most of the larger fountains, this type has the jets for the water arranged around the rim of the basin, letting the spray fall inward upon a glass plate through which the light of an incandescent lamp penetrates the finely divided particles of water. In running off this glass plate the water turns a little waterwheel of the old-fashioned bucket type, which is geared to a glass cylinder surrounding the lamp. The cylinder is colored in sections, so that the spray changes from blue through green to yellow, from orange to red and then through purple back to blue. A single 32 candle-power lamp is used, thus requiring very little current, and as the waste water works the color changes, no motor is needed for this. Hence the cost of operation is very small, although the effect is a charming one



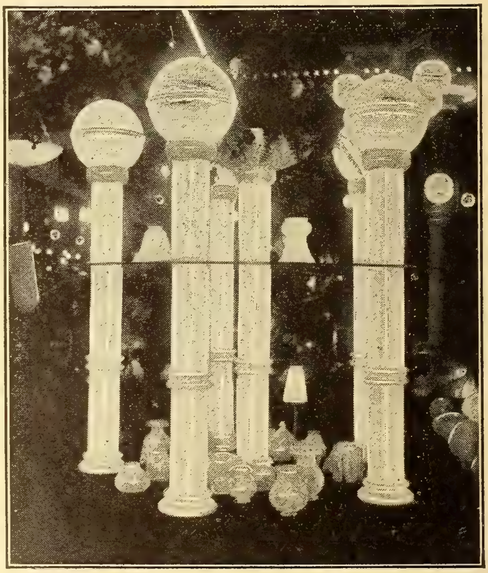
COLOR CHANGING FOUNTAIN



A LITTLE WATER WHEEL CHANGES THE FOUNTAIN COLORS

Pillars of Glass

Little beyond mere mention is needed to recall to the memory of Chicago Electrical Show visitors the beautiful marble like pillars of Alba glass surmounted by globes of the same material in the Macbeth-Evans exhibit. Illuminated from within, these pillars afford a most strikingly beautiful decorative effect which can be compared only to alabaster marble. Reflectors and globes made from this material have high diffusing power.



PILLARS OF GLASS

JUNIOR SECTION

Construction of Small Motors and Dynamos

By CHAS. F. FRAASA, JR.

CHAPTER IV.—BEARINGS, SHAFTS, COMMUTATORS, BRUSHES AND BRUSH HOLDERS

The bearings for the models are shown in Figs. 13 to 15 of this chapter, and the dimensions are given in tables III and IV. Fig. 13 shows the method of shaping the bearings. There are three successive stages shown in this illustration: first, the strip of metal of which the bearing is made is cut in from both ends; second, the ends are bent apart after heating, and third, in the final shape the arms are bent so as to be perpendicular to each other.

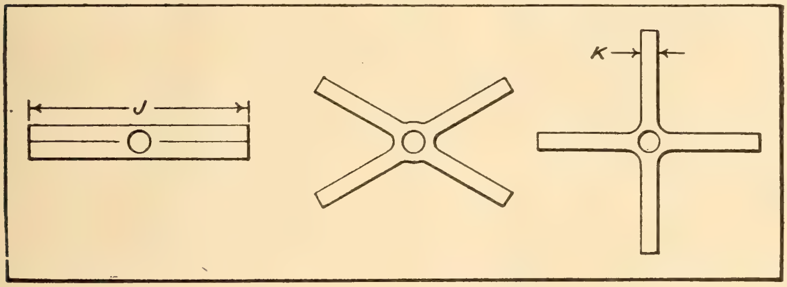


FIG. 13. METHOD OF SHAPING THE BEARINGS

For the 50-watt size, the material is ¼ inch thick, and for this purpose procure from the blacksmith, a strip of soft steel ¼ inch thick by two inches wide, and about fifteen inches long, and either have the blacksmith finish it, or do it yourself. Saw a line down the centre of each end of the strip, as shown in Fig. 13, heat the strip, and work to shape.

When the bearing is of the proper shape, place on the boring machine and drill a 13-16-inch hole in the centre, and through this hole place a piece of ½-inch (internal diameter) brass pipe, 1½ inches long. In the smaller sizes this brass pipe should be driven in at a tight fit, but in the larger sizes must be held in place by small set screws. The holes for the bolts of the field magnets which hold the bearings in place should now be drilled. Reference to Figs. 14 and 15 will make this plain.

A grease cup, shown in Fig. 16, is a valuable addition to the bearing. To make this, drill a one-inch diameter hole in a piece of

TABLE III
DATA FOR PULLEY END BEARINGS, REFERRED TO FIG. 14
(K EQUALS 1 INCH FOR ALL TYPES)

Type	A Curve Radius	B	C	D	E	F	G	H	I	J	L
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
A	3½	¼	5	1	7	¾	2¾	½	5-32	12	1½
B	3½	¼	5½	1¼	7⅞	¾	2¾	¾	5-32	14	1½
C	4½	½	6	1⅜	9¼	1	3¼	¾	5-32	16	1½
D	4½	½	7	2	11⅜	1	4	1	5-32	18	2

TABLE IV

DATA FOR COMMUTATOR END BEARINGS, REFERRED TO FIG. 15
(K EQUALS 1 INCH FOR ALL TYPES)

Type	A Curve Radius	B	C	D	E	G	H	I	J	L
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
A	3½	¼	5	1	7	3⅜	½	5-32	14	1½
B	3½	¼	5½	1¼	7⅞	4	¾	5-32	15	1½
C	6	½	6	1⅜	9¼	5¼	¾	5-32	16	1½
D	7	½	7	2	11⅜	6¾	1	5-32	18	2

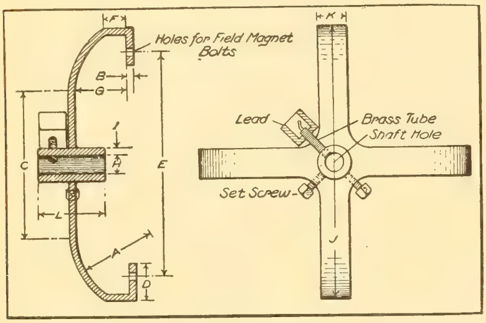


FIG. 14. PULLEY END BEARINGS

one-inch wood, and fasten by means of tacks a thin piece of wood on each side of it covering the hole. Drill holes through the two thin cover-boards, their centres coinciding with the centre of the one-inch hole, and put a piece of ¼-inch (internal diameter) brass pipe through one side till it extends into the large hole about one-fourth inch. Then put a wooden plug in the end of the pipe in the block, and pour molten lead into the other hole, (A) Fig. 16. The casting should now be removed from the mould, and a ½ or ¾-inch diameter hole drilled in the top, down to the tube. Remove the plug in the tube, and put a wick in it. This makes a very good grease cup.

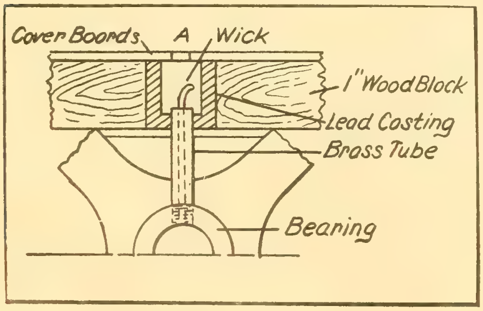


FIG. 16. GREASE CUP

The end of the brass tube should not be threaded, and should be screwed into a threaded hole in the brass bearing.

The dimensions of the shaft are shown in Fig. 17, referred to table V. The shaft may be cut from material similar to that of the shaft of the boring machine and may be turned to shape, but must not be cut off until all the machine work is done. The shaft is turned in the same manner as the armature core (see Chapter III), and with the same tool holder. The tool holder is fastened at the proper place by the same method as was employed in turning the armature—inserted through a hole in the bed of the boring machine and clamped by lock nuts. At the position which the armature and commutator will occupy, cut a slot or keyway in one side of the shaft with a small cape chisel. This slot or keyway should be ¼ inch wide by about ⅛ inch deep, so that a key of the above size will fit into it tightly. One of these keys is shown in the illustration of the commutator, Fig. 18.

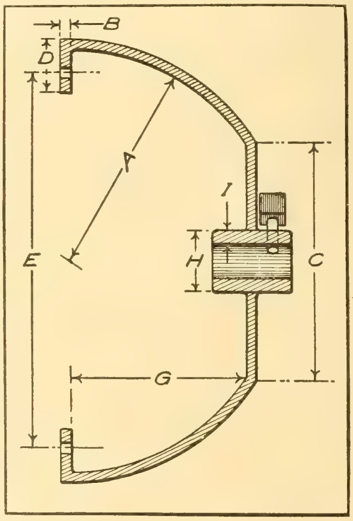


FIG. 15. COMMUTATOR END BEARINGS

The commutators of these small machines are very simple in construction, being composed of a hardwood core on which are fastened the segments, cut from a short piece of brass tubing. The commutator is

TABLE V

DATA FOR SHAFT DIMENSIONS, REFERRED TO FIG. 17

Type	A	B	C	D	E	F	G	H	I
	in.	in.	in.	in.	in.	in.	in.	in.	in.
A	2	1½	6¾	1½	1½	½	1	¾	½
B	2	1½	6¾	1½	1½	¾	1	¾	¾
C	2	1½	9½	2	1½	¾	1	¾	¾
D	3	2	11¼	3	2	1	1	1	1

shown in Fig. 18, and is dimensioned in table VI. It is fastened to the shaft by means of a key, as shown.

To construct a commutator for the 50-watt machine, mount on the boring machine shaft a piece of oak about ¾ inch long, and of sufficient diameter for turning a cylinder 2½ inches in diameter. Turn down as smooth as possible and shellac its surface. Obtain a ¾-inch piece of 2½-inch (internal diameter) seamless drawn brass tubing and drive onto the cylinder. If making a commutator for the two-pole field, divide its perimeter into eleven parts by eleven equally spaced lines drawn parallel to the shaft; if for the four-pole field, divide it into 33 parts. The 100-watt commutator with a two-pole field should be divided into eleven equal parts; the 300-watt, thirteen, and the 800-watt, fifteen. On the four-pole types: 100-watt; 33 parts; 300-watt, 39; on the 800-watt, 45.

Between the lines drawn on the commutator, and near the ends of the tube, drill one pair of holes to each segment marked off. Use flat-headed screws in the hole on one end and round-headed screws on the other. The flat-headed screws should be countersunk. When this is done cut the commutator tube into segments, by cutting the metal out along the lines with a hacksaw, cutting entirely through into the wood. Be careful that the segments are separated, and brush out all small saw cuttings from the saw cuts.

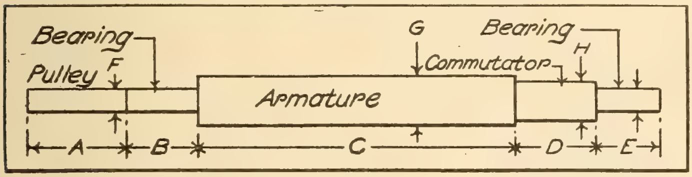


FIG. 17. SHAFT

Now loosen up the screws on the segments, and raise one segment at a time, and by means of shellac, fasten enough mica in the saw slots to completely fill them. Then screw the segments down tightly, and on the boring machine, turn down the face of he commutator and the flat-headed screws with a light cut. The armature leads are to be connected under the round-headed brass screws.

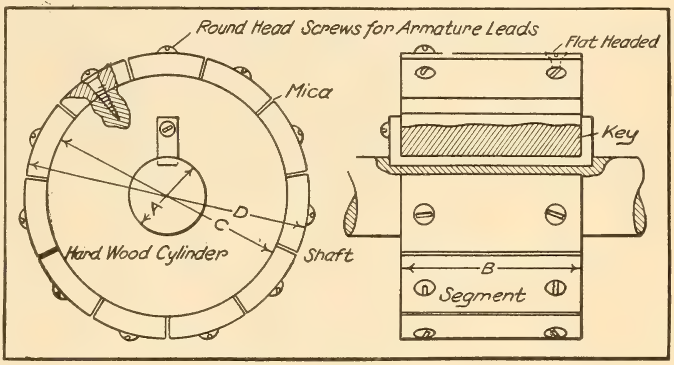


FIG. 18. COMMUTATOR

The brush holders Fig. 19 of these machines are all designed for carbon brushes. These brushes may be cut down from larger sizes

TABLE VI

DATA FOR COMMUTATOR DIMENSIONS, REFERRED TO FIG. 18

Type	A	B	C	D
	in.	in.	in.	in.
A	¾ or 1	¾	2½	2 13-16
B	¾ or 1	1	2½	2 13-16
C	1	1¼	3	3½
D	1	2¼	3	3½

if the proper sizes are not at hand. The dimensions of the brushes are given in table VII under (A) and (F). The brush holders are made of a strip and a block of copper or brass. The strip, cut to the dimensions shown, should be bent to shape, and the block, $\frac{1}{4}$ by $\frac{1}{2}$ by $\frac{3}{8}$ inch fastened in place by screws. Drill and tap a hole in the top of the $\frac{1}{4}$ by $\frac{1}{2}$ by $\frac{3}{8}$ inch block for a screw which is used as a connector for flexible brush leads. Drill the holes for supporting the holder on the rod (R), in the end of the holder. Then drill and tap the hole of the screw (T) which clamps the brush in place. Cut the rod (R) to the proper length; thread the two ends, and cut a slot down one end with a hacksaw for the spring. Insert a piece of clock-spring in this slot, and bend it so that it will bear down on the brush as illustrated. Washers and nuts should be placed on both ends, and the brush holder fastened to the rocker brush support, Fig. 20. The rod (R) should be insulated from the support by an insulating bushing and washers. For the two pole machine, two brushes will be required; for the four-pole, four.

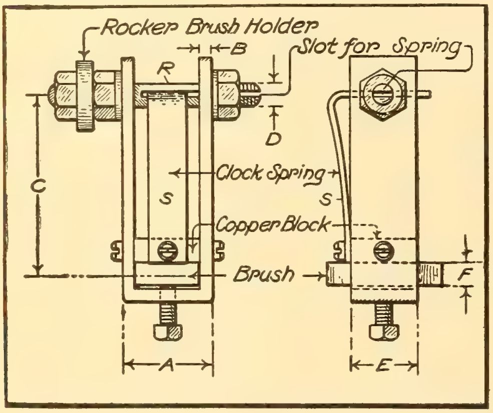


FIG. 19. BRUSH AND HOLDER

TABLE VII
BRUSH HOLDER DIMENSIONS REFERRED TO FIG. 19

Type	A	B	C	D	E	F	F
	TWO POLE AND FOUR POLE					Two Pole	Four Pole
	in.	in.	in.	in.	in.	in.	in.
A	5-16	$\frac{1}{8}$	$1\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	5-16	$\frac{1}{4}$
B	$\frac{3}{8}$	$\frac{1}{8}$	$1\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{4}$	$\frac{1}{8}$
C	$\frac{3}{4}$	$\frac{1}{8}$	2	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{8}$
D	$1\frac{3}{4}$	$\frac{1}{8}$	$2\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{8}$

TABLE VIII
ROCKER ARM BRUSH HOLDER DIMENSIONS, REFERRED TO FIG. 20

Type	A	B	C	D	E	F
	in.	in.	in.	in.	in.	in.
A	13-16	$1\frac{3}{4}$	$2\frac{1}{4}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$
B	1 1-16	$2\frac{1}{4}$	$2\frac{1}{2}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$
C	1 1-16	$2\frac{1}{4}$	$2\frac{5}{8}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$
D	1 5-16	$2\frac{1}{2}$	$3\frac{1}{8}$	$\frac{3}{4}$	$\frac{3}{8}$	$\frac{1}{2}$

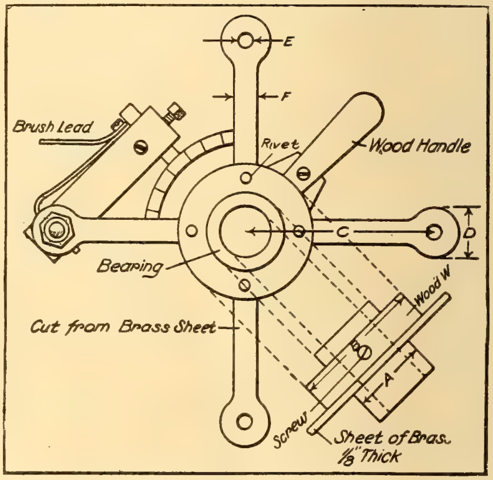
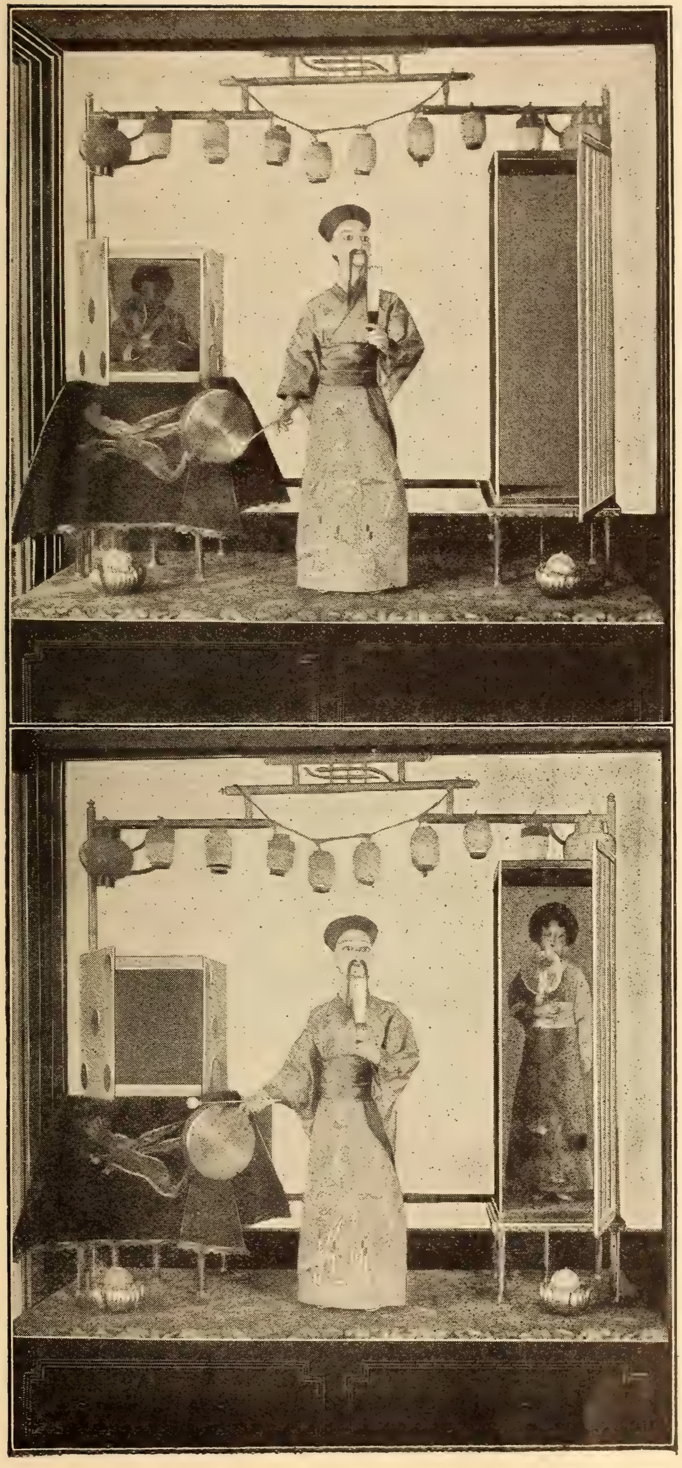


FIG. 20. ROCKER ARM BRUSH HOLDER

The rocker arm brush holder, Fig. 20, should be cut to shape and dimensions given in table VIII, and should have fastened to it a block of wood (W) with a hole through the centre the size of the brass bearing tube. This is to support it upon the bearing, and contains a wood screw for tightening it in position.

(To be Continued.)



THE STRANGE DELUSION OF THE VANISHING LADY

The Vanishing Lady

Almost as real as if of flesh and blood instead of wax, this little bright-eyed Oriental magician clad in silk gown and turban and enclosed in a glass case, entertains both the children and grownups as he shows in pantomine that he is about to do something mysterious.

Upon each side of him is a metal cabinet, one oblong, the other a cube, each with hinged doors.

To begin his mysterious act, at his first gesture both doors open, the lamps on the platform light up and the cabinets are seen to be empty. The doors then close as with a nod of cunning the wax wizard turns to his right and strikes a gong suspended at the corner of the table. Immediately the cabinet door opens disclosing a lady seated within clad in a silk kimono, and holding [a fan in her right hand. The door closes, then both cabinet doors open, the lamps light, and my lady has vanished. At a wave of his fan toward the oblong cabinet the door opens and there she is found standing up with the fan still in her hand. The door closes and again both doors open. The lady has disappeared and the cabinets are found unoccupied as at first. The scene is made more weird by the light from eight small lamps within Chinese lanterns suspended over the magician's head and the little folks exclaim in wonderment, "How does he do it?"

A little electric motor and small flasher are located under the platform. The lady in the cabinet at the magician's right eludes the eye by being lowered floor and all into the table which, of course, is covered by a beautiful table cloth, and a false floor above her head comes down, too, covering her up

You might also arrange to have the water from the overflow pipe move a lever arm and and taking the place of the floor she sits on. Her twin sister who stands up all the time is fastened to a velvet-covered revolving board which the motor by means of wheels and belts quickly turns half round while the door is closed.

This interesting device may be seen in the children's play room on the eighth floor of Marshall Field's, Chicago.

THE YOUNG EDISONS' CLUB

Under this heading will be published letters from readers of the Junior Department. These letters should describe briefly and accurately your experiences in the making and operation of electrical devices and in the performing of electrical experiments. See how good an "engineering report" you can make of your investigations.

The Young Edisons' Club:

Here is a description of a high water alarm designed to be used in a place where you have to pump water from the cellar up into a tank in the attic. It saves you the trouble of climbing up stairs every little while to see if the tank is full.

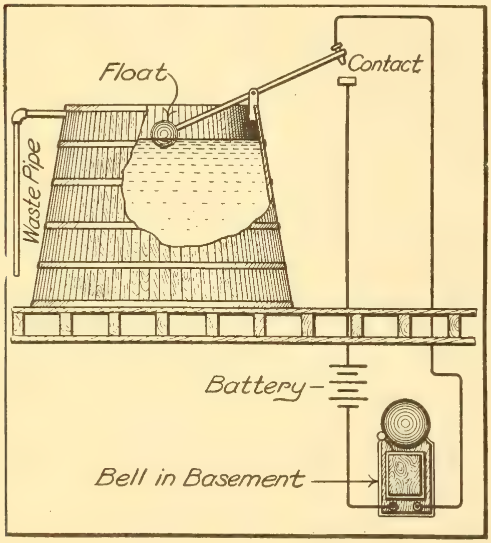


FIG. 1

Pivot a lever arm on the edge of the tank so that one end will tip down into the tank. Arrange a float on the end of the lever so that it will be lifted when the tank is nearly full. Arrange a bell circuit so that the circuit will be closed when the water reaches a certain height (Fig. 1).

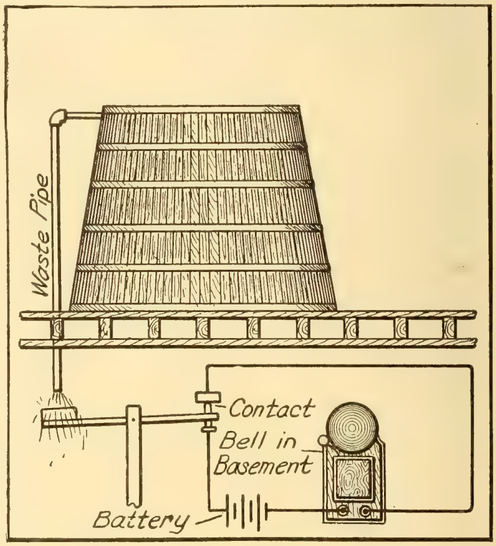


FIG. 2

during shopping hours a crowd of the curious of all ages may be found in front of it.

close the circuit when the water begins to flow from the pipe outside the house (Fig. 2).

HAROLD H. LEWIS.

617 N. Fayette St.,
Saginaw, Mich.

The Young Edisons' Club:

My shop is built of scraps and boxing lumber and is 8 by 10 feet 6 inches. The roof is shingled and I have it whitewashed inside to make it lighter.

My equipment, which I bought outright, consists first of a dynamo (20 volts, 4 amperes, 80 watts at 2000 revolutions per minute). This I drive with my 2½ horsepower Shaw motorcycle engine. I put a sewing machine fly wheel on the dynamo to steady it. Besides this I have twelve Edison key sockets, twelve Edison base 14-candle-power lamps, 300 feet No. 14 R. C. wire, 30 feet No. 16 lamp cord, switchboard (soft wood, 24 by 30 inches), one voltmeter 0 to 25, one field rheostat, two switch and fuse blocks, eight four-ampere fuses, one single pole switch and one double pole switch.

For tools I have two screw drivers, one compass saw, one hand saw, one hack saw, four bits (¼, ⅜, ¼, 1), three drills (3-32, ¼, 5-32), one brace, one cold chisel, one punch, one hammer, one rivet set, one soldering copper, one pair tin snips, two awls and two planes.

My library consists of one "Physics," one "Easy Experiments in Electricity," one "Amateur Mechanics," POPULAR ELECTRICITY and *Popular Mechanics*.

When I get my wireless I will have a nearly complete shop. I have already made two telephones, I have one in the shop and one in the house. These were made from so-called worthless parts. But I found only a little labor would make them as good as new.

F. R. STERLING.

Box 772,
Hartington, Nebr.

The Young Edisons' Club:

My experience with electricity is of course only as an amateur, but I will first tell you how I first became interested in electrical matters. When I was attending High School, I boarded with a fellow student who studied physics. He became interested in making an electric bell and of course I was anxious to learn what kind of a thing an electric bell was and to help him. After a good deal of experimenting and studying we made a contrivance which would buzz, but not ring, as we did not have the facilities for putting the bell part on. The magnet was about three and one-half inches long and two inches wide across the poles. We had wound the magnet with No. 28 magnet wire, which as you know is too fine for an electric bell to be operated by batteries. It worked fairly well, however, on three cells. It was an awkward looking affair, with a wooden base about ten inches in length and seven in width. We didn't even have a then cover for it to keep the dust out.

Our success with the electric bell of course made us more anxious to make some more apparatus; so we decided to make a spark coil, but our lack of finances would not then allow it.

About two months later I purchased a half pound of No. 16 magnet wire and a quarter of a pound of No. 29. I used the No. 16 for the primary and the No. 29 for the secondary and constructed an induction coil which would give a good shock when run on two or three dry cells. I used to have lots of fun with my induction coil with my friends as I could give them good smart shocks when they were least expecting it. I also made a good shocking coil out of an ordinary telephone induction coil, by simply winding more wire onto the secondary.

I have never bought any new batteries. Instead I would get the worn-out batteries from the telephone office and renew them. This I would do by cutting the zinc open on one side and removing it, being careful not to break the paper or pasteboard on the inside. Then I would scrape the zinc clean and sandpaper the outside, then place it carefully on the carbon element again, tying it in place with a cord. Then I take a quart fruit jar or bottle and remove the top in the following manner: Wrap four or five thicknesses of string around the top just above where you intend to take it off, saturate it with kerosene, light it and it will usually break off just above the string; if it does not, dash it into cold water, top first, which will generally take it off. Now place the cell in the jar and fill the latter with rain water and add enough sal ammoniac to make a good strong solution. After the cell stands for a few minutes it is ready for use. I have two of these cells in operation now and they do fine work on my "Little Hustler" motor and doorbell. Of course more cells could be "fixed up" in this way, but I think I would connect them series-multiple so as to get more current. One of these cells has been in operation more than two weeks and I can't see that the zinc is consumed a bit yet.

Do not pay any attention to anyone who tries to make fun of you for "monkeying" with "electrical things."

ORLO MUTCHLER.

202 Herkimer Ave.,
Allegan, Mich.

POPULAR ELECTRICITY WIRELESS CLUB

Membership in Popular Electricity Wireless Club is made up of readers of this magazine who have constructed or are operating wireless apparatus or systems. Membership blanks will be sent upon request. This department of the magazine will be devoted to the interests of the Club, and members are invited to assist in making it as valuable and interesting as possible, by sending in descriptions and photographs of their equipments.

A High-Power Wireless Equipment

By ALFRED P. MORGAN

PART XII.—POTENTIOMETER; FIXED CONDENSER

The action of the electrolytic detector has already been explained in detail, but in order more fully to understand the purpose and usefulness of a potentiometer it may be well to recall that when the positive half of the wave is passing, the voltage of the high frequency currents is sufficient to break down the film of gas on the Wollaston wire point and permit the battery current to flow.

The purpose of the potentiometer is to lower the voltage of the battery to such a point that it is insufficient of itself to break down the film of gas but still is strong enough to quickly reform the film of gas after it has been broken by the high frequency currents and the latter have ceased to pass.

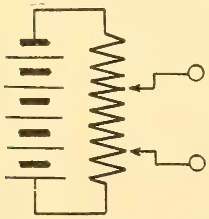


FIG. 132. RESISTANCE IN PARALLEL

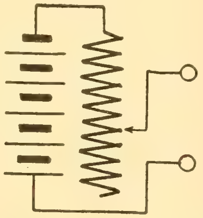


FIG. 133. RESISTANCE IN SERIES

In construction, a potentiometer is merely a variable resistance shunted across the terminals of the battery as in Fig. 132. If placed in series with the battery as in Fig. 133, it would serve merely to regulate the current strength in the circuit. When connected in parallel with the source of current it is the voltage which is varied.

In order to understand this action, which is the principle of the Wheatstone bridge, the fall of potential along a wire must first be explained. If any electrical circuit connected with a source of current supply is carefully examined, it will be found that the potential falls off as the distance away from the source of current becomes greater. In other words, the voltage drop between two points in a circuit is proportional to the resistance between the points.

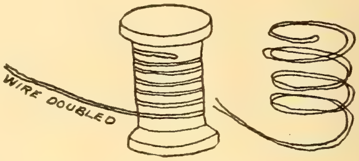


FIG. 134. NON-INDUCTIVE WINDING

Potentiometers are made in two forms, the first employed usually by makers of amateur wireless telegraph instruments, wherein the resistance is in the form of a graphite rod or a hard rubber rod wound with German silver wire and having a ball bearing slider or wheel rubbing over it. The second is more often used in connection with commercial apparatus and the resistance consists of a number of coils of wire variable by means of a multi-pointed switch.

I have chosen this latter type to describe because it is not only more satisfactory but also because it is more in keeping with the remainder of the apparatus.

The resistance units consist of coils of German-silver wire wound carefully in the non-inductive manner shown in Fig. 134. The wire forming each coil is doubled back on itself before being wound in order to avoid self-induction and not unbalance the detector circuit whenever the adjustment of the potentiometer is changed.

The coils number 22 all told. Eleven coils have a resistance of 35 ohms apiece and the other eleven 33 ohms together or three ohms apiece.

The table given below shows the length of wire for several sizes required to form each coil. The proper lengths should be measured off and then rolled up in the manner stated.

GERMAN SILVER WIRE—18 PER CENT

NO. B.&S.	LENGTH OF WIRE IN 35 OHM COILS	LENGTH OF WIRE IN 3 OHM COILS
30	18.5 feet	1.6 feet
32	11.9 "	1.0 "
34	7.3 "	0.6 "
36	4.5 "	0.4 "

The case of the instrument is ⅜-inch mahogany, built so as to form a box whose outside dimensions are 6 by 4½ by 2¾ inches. The top and bottom of the case project slightly beyond the sides so as to improve its appearance.

The details of the contacts and the switches are shown in Fig. 135. The contacts are turned out of 5-16 inch brass rod and are threaded with an 8-32 die at the lower end. They are ⅞ inch long over all and 3-16 inch high above the top of the case. They are set equidistantly around the circumference of two circles each 1⅝ inches in diameter.

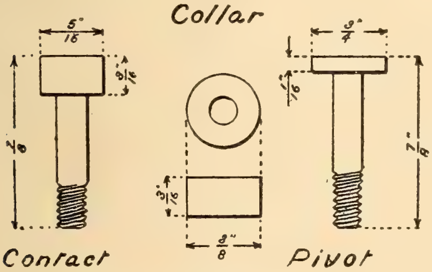


FIG. 135. DETAILS OF CONTACTS AND SWITCHES

A hexagonal brass nut having an 8-32 thread is screwed on the lower end of the contact so as to hold it firmly in place. After all the contacts are in place the resistance units are fastened in the bottom part of the case by gluing around the sides. Connections are established to the lower ends of the contacts by soldering.

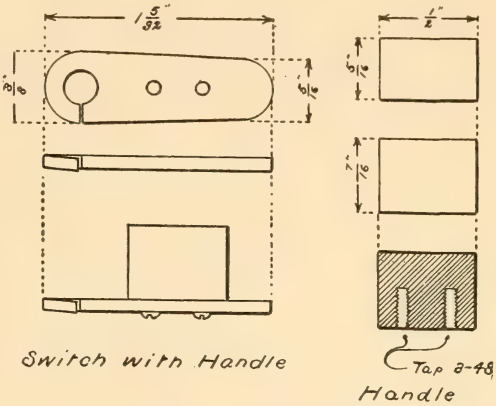


FIG. 136. DETAILS OF SWITCH ARMS AND HANDLE

All of the 35-ohm coils are connected in one group and all of the three-ohm coils in the other.

The switch arms are cut out of 1-16-inch hard sheet brass as shown in Fig. 136. The pivoted end of the switch is cut and bent down so as to form good contact with the pivot at all times. A brass collar ⅜ inch in diameter and 3-16 inch thick is placed under the switch so as to bring it level with the tops of the contacts.

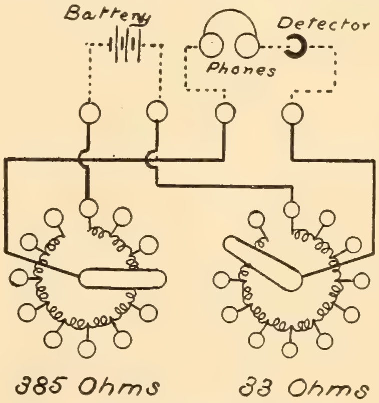


FIG. 137. CIRCUIT DIAGRAM

The handles are formed of two small hard rubber blocks ½ inch long, 7-16 inch high and 5-16 inch thick. They are polished in a buffing wheel charged with wet pumice stone or tripoli powder. Two 3-48 brass screws passing through the switch from the under side into each block hold them in position.

The connections are shown by the diagram in Fig. 137. The heavy wires leading from the resistance units lead to two binding posts which are connected to the battery. The two switch arms connect to two other binding posts which in turn are connected to the detector and to the telephone receivers.

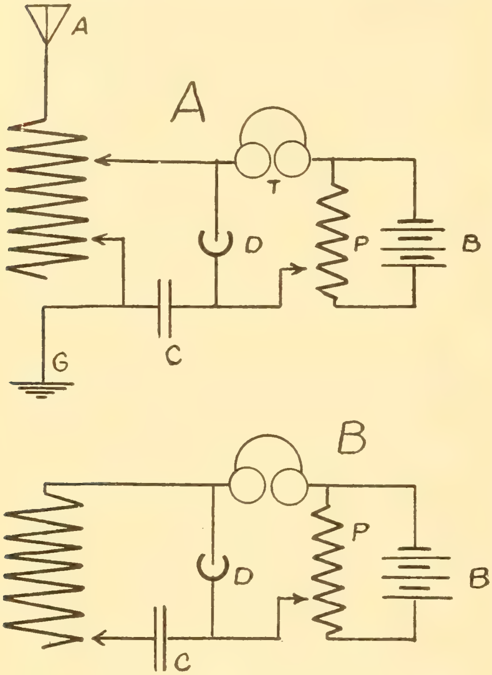


FIG. 138. RECEIVING CIRCUITS WITH FIXED CONDENSERS

FIXED CONDENSER

Condensers for use in the receiving circuit of a wireless telegraph installations may be divided into two types, those which are adjustable or variable and "fixed" condensers whose capacities may only be altered in steps. To the former class belong the rotary plate, sliding plate and sliding tube types which have air as a dielectric. Those are used exclusively for tuning purposes and therefore may be dismissed from our attention at the present.

Fixed condensers usually employ paper, mica or thin glass as a dielectric. They are necessary in the receiving circuit in order to prevent the turns of the tuning coil which are included in the closed circuit from forming a short-circuit around the battery and the telephone receivers. This will be readily understood from the two circuits shown in Fig. 138.

The first one (A), represents the arrangement of an ordinary "close" coupled double slide tuning coil while the second (B) illustrates the secondary circuit of a "loose" coupled system.

The proper capacity for a fixed condenser is dependent upon conditions peculiar to each receiving set. It is something which if the best results are desired it is impossible to predetermine. I always prefer to build several condensers of varying capacity and pick out the best one by experiment. If the capacity is too small it will weaken the signals while if too large the signals will sound "mushy". The proper capacity will render the signals sharp and clear.

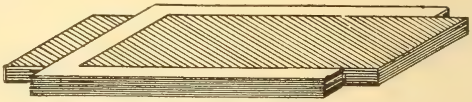


FIG. 139. FIXED CONDENSER, "BUILT UP" TYPE

The most desirable fixed condenser for receiving purposes is that type known as a "built-up" condenser and which consists of a large number of small sheets alternately paper and tinfoil laid one on top of the other as opposed to the roll condenser which consists of a smaller number of large sheets rolled up so as to occupy a smaller space. It has been found that a roll condenser cannot charge and discharge as rapidly as a "built-up" condenser.

In making a condenser for this purpose it is sometimes a good plan to divide it into several units and then by connecting the units in various ways several values of capacity may be obtained. Two condensers of equal capacity connected in parallel have twice the capacity of one, while in series they will have only one-half the capacity of either.

The condenser described below will be found to be as nearly suited to the average receptor as it is possible to obtain without experiment.

It is composed of sixteen sheets of tinfoil 1½ inches wide and three inches long. The paper is a good grade of linen .005 inch thick carefully prepared by dripping in a molten bath of clean paraffin until all bubbles cease to rise. It is hung up to dry and then cut into strips, 1½ inches wide and three inches long. The paper and tinfoil strips are piled up alternately allowing about 5-16 inch on each tinfoil strip to project beyond the paper as shown in Fig. 139, alternately, first on one side and then the other.

Place the condenser between two flat boards which may be squeezed together with a clamp and put them in an oven which is hot enough to melt the paraffin. As soon as the paraffin on the paper has thoroughly softened, tighten up the clamps and set the condenser away to cool.

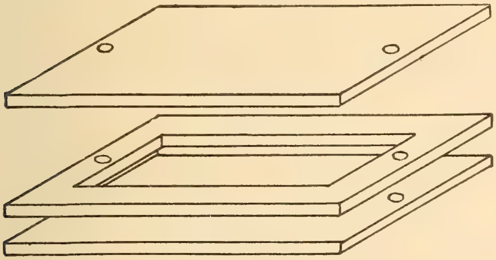


FIG. 140. CONDENSER CASE

As soon as cool it may be removed from the clamps. It should be firm and hard enough to hold together.

The tinfoil strips are bunched together at each end and soldered to a stranded copper wire.

If desired the condenser may be placed in the base of the detector or mounted in a case of its own. If the latter, the scheme shown in Fig. 140 will be found to be very effective. A rectangular hole 3½ inches long and 1¾ inches wide is cut and is the centre of a piece of hard rubber 3-16 inch thick, 4¾ inches long and 2¾ inches wide. The corners are rounded so as to give a finished appearance to the case.

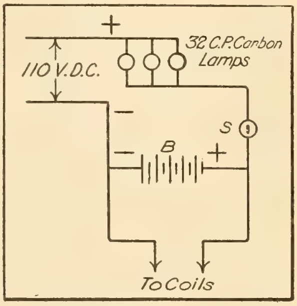
The sections may now be fastened together by two brass machine screws which pass through at both ends as shown in the illustration. The condenser is placed in the case and connections established to the screws. These may be passed through the sides of the potentiometer box or the detector case and secured on the under side with a hexagonal unit, making a neat and compact unit.

(To be Continued.)

Operation of Spark Coils on 110 Volts

Many letters have been received of late requesting information as to how spark coils may be run on 110-volt electric light circuits. Most coils used by experimenters are designed to operate on from six to twelve volts, and a well designed coil should not consume more than eighteen watts per inch of rated spark length.

The use of an electrolytic interrupter in series with a battery spark coil on 110 volts is often the cause of the insulation of the secondary winding breaking down. The prime reason for this is that there is no electrolytic interrupter on the market at a low price which will operate satisfactorily unless a current of 20 amperes or more is passing through it. If this combination is used in connection with a circuit of 110 volts pressure, 2,000 watts or more are being used in the coil, depending upon the resistance of the electrolyte used in the interrupter and the amount of surface exposed at the "point." Since the coil was made to consume from eighteen to 75 watts, depending upon its size, the use of an electrolytic interrupter as described greatly overloads the coil and causes considerable heating of the windings. Moreover, the voltage produced in the secondary of a coil connected in this way is many times higher at the moment the current is broken by the interrupter than that for which the coil was designed, and consequently many breakdowns occur.



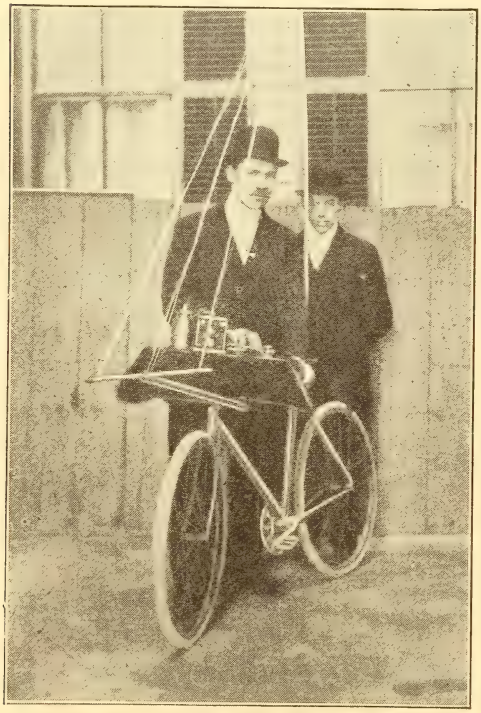
SPARK COIL ON 110 VOLTS

One of the most satisfactory ways to operate a battery spark coil on 110 volts D. C is illustrated. The battery (B) may be a set of dry cells connected in series, or a storage battery of the proper voltage for the coil. As many 32-candle-power lamps should be connected as shown as will give the number of amperes the coil consumes. The battery acts as a voltage reducer and will last almost indefinitely if switch (S) is "on" while the coil is being used, and "off" at all other times. This method does not cause flickering of the lights in the house when the key is depressed and the coil cannot possibly be damaged. In connecting be sure that the positive (carbon, in the case of a dry battery) is connected to the positive wire of the electric lght circuit.

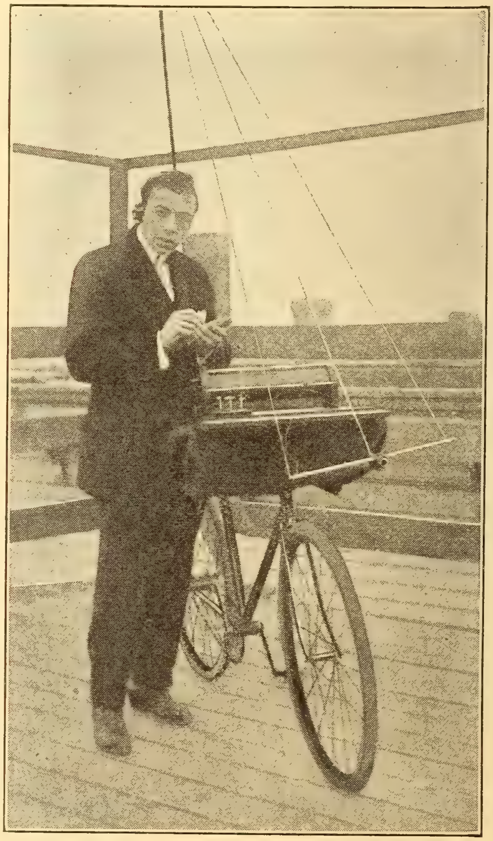
One of the most satisfactory and safe ways to operate a battery spark coil on a 110-volt A. C. circuit is to revolve the adjusting screw of the vibrator until it cannot operate, and to connect the coil in series with two ten-inch gas lighting spark coils. These coils consist of one winding of wire. The spark coil then acts as an open core transformer, and the gas lighting coils act as a reactance. The spark produced by the coil with this method is short and thick, like that of a transformer, and large spark gap terminals should be used to prevent their overheating. It will also be found that a larger condenser connected in the secondary circuit will be needed. A. B. COLE.

Wireless Without a Ground

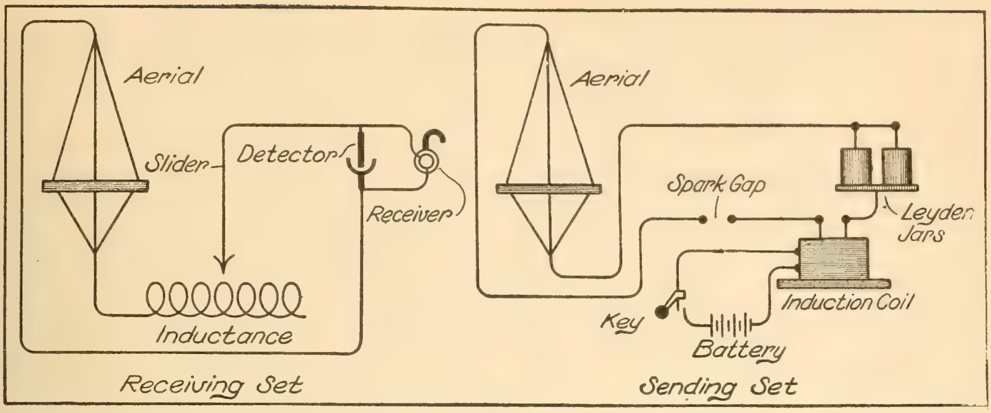
The sending of wireless messages through space without a ground at either station has been demonstrated by the inventors, Messrs. Jonescick Bros. of Cambridge, Mass., and I. Wolff of Roxbury, Mass. The experiment was made by means of a complete sending and receiving set of apparatus mounted on bicycles including the aerial, as seen in the photographs. No ground wire was used, as the rubber tires prevented any con-



SENDING SET



RECEIVING SET



CONNECTIONS OF BICYCLE WIRELESS OUTFIT

nection or leak of the high frequency oscillating currents to escape through the frame and wheels.

The sending apparatus of the set consisted of a three-inch spark coil, two high tension leyden jar condensers connected in multiple, a spark gap, and an operator's key. The entire set was mounted rigidly on a board 8½ by eighteen inches. A set of six dry cells which operated the coil was placed underneath the board, and the complete station fastened to the handle bar of the bicycle. The operator would guide the bicycle with one hand and operate the set with the other.

The receiving apparatus of the set, which was operated by Mr. Wolff, consisted of a large inductance coil equipped with a sliding contact so as to provide accurate tuning when necessary, a sensitive piece of silicon used in a high tension adjustable mineral detector holder, a switch and one 2,000-ohm double pole laminated core magnet receiver, wound with copper wire, held on the head by means of a head band. The entire set was mounted on a board and fastened to the handle bar of the bicycle as seen in the photograph, and operated in the same manner as described in the sending set.

The aerials of the two sets were equivalent. Each was made up of a ten-foot pole (a bamboo fishing rod ten feet long) fastened to the back of the seat on the bicycle, and three wires each 12½ feet long of phosphor bronze. These were constructed in the shape of a cage, connected at top and looped in one at the bottom, which was suspended on a cross bar as shown in the photographs. All connections were permanent and rigidly clamped so as to prevent trouble.

The lack of space for a helix in the sending circuit compelled the construction of a double wire spread in the aerial used by Mr. Jonescick in his sending set.

Where both sets were to be used as one, the clear space on the board, as shown to the right of the photograph representing the receiving set, was left for placing the sending apparatus.

A distance of about 2½ miles was covered with great success, on the evening of February 4, 1911, at 10:30 p. m., and the distance of about 3½ miles on the morning following at 2 a. m. When covering the last distance one of the operators was situated at the foot of the N. Harvard St. Bridge and the other at the foot of the Cambridge Bridge along the banks of the Charles River. Boston, Mass.

H. FRANK.

Solder for Detector Crystals

Most of the articles published on detectors recommend ordinary solder for holding the crystals in the cups. For one who is willing to take the trouble to get the bismuth, the alloy here described is better. Its convenience lies in its low melting point, which is very near the temperature of boiling water. The composition of the alloy is as follows: Bismuth two parts (by weight); lead one part; tin one part. The lead is first melted and the tin added, then the bismuth put in and stirred, the temperature being kept only high enough to keep the alloy melted, otherwise the tin becomes oxidized and forms a scum.

J. H. STEWART.

Hints on Increasing Efficiency

By GEORGE F. WORTS

There is hardly any portion of the amateur's transmitting set that is not susceptible to improvement of some kind. Leakage and incorrect capacity are about the commonest faults. In insulating wireless sets, it should be borne in mind that though rubber and glass rank high as dialectrics their surface leakage is extremely high. Where a great difference of potential exists across a small area, such as in a helix or spark gap, fibre, though ranking low as a dialectric, should be used as its surface leakage is low as contrasted with rubber and glass. Slate will nearly always be found to contain metallic veins that are conducting paths for high voltage currents and therefore undesirable for all but low voltage insulation. Wood may be used on most all high voltage insulation as it appears to hold up very well under most conditions.

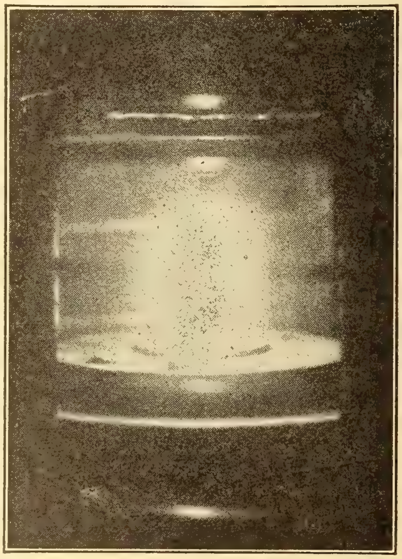
Connecting wires should lead in as straight a line as possible to the instruments as sharp corners incur leakage, while numerous turns introduce extra inductance and will possibly unbalance an otherwise well synchronised circuit.

The induction coil has been gradually superseded by the closed core transformer, which is much more efficient, cheaper to build and costs less to run. Experiment has proven that the type of closed core transformer in which the primary is wound upon one side or "leg" and the secondary upon the other side, is practically as efficient as the type in which part of the primary and secondary are wound upon each leg and is cheaper to build.

Of late, amateurs have awakened to the fact that high voltage transformers will send considerably farther than those of low voltage. The commercial companies have realized this for several years and consequently use transformers producing 25,000 to 50,000 volts. It is impossible to use this high voltage on low power, amateur wireless sets, as the amperage of a 250-watt transformer is so low if over 15,000 volts is used, that it will not charge condensers satisfactorily. However, the amperage at 15,000 volts of a properly designed, 250-watt transformer will, with condensers, produce a fat spark about ⅜ of an inch in length, that has marvelous powers for sending. Without condensers a worm-like flame will jump between points about ½ inch apart. It may be easily drawn out to 1½ inches.

A ½ K. W. transformer wound to give 20,000 volts on the high side will charge condensers rapidly enough to give a working spark of over one inch, see illustration.

The use of the high voltage transformer makes possible the use of the high speed rotating gap, the advantage of which lies in the sharp and even spark that results from its use. A high pitched tone may be also produced by a series gap. A satisfactory experimental series gap can be made by driving a row of copper tacks in a well seasoned board. Their heads should protrude ⅛ inch and be separated 1-32 inch. The number will depend, of course, on the voltage. The tone at the receiving end is clear and almost musical. Tests have proven that the sensitiveness of high resistance wireless receivers increases with the increase in the height of the pitch of the tone. Fessenden and Stone, observing this, have brought out their well known singing spark



SPARK FROM A ½ K. W. TRANSFORMER

apparatus that has about revolutionized wireless commercially. The cost of high frequency generators which are necessary in this type of transmitter, prohibit its use by amateurs. However, by the use of a series or revolving gap with a high voltage transformer and condenser, a fairly high pitched tone may be produced that is suitable for most amateurs' requirements.

In designing high voltage transformers, the insulation enters as a prime factor. Primaries should be well insulated between consecutive layers and all secondary windings should be subjected to an impregnating process in slowly boiling refined paraffin for a long period. If the secondaries are wound pancake style, which is a much more efficient though difficult method of construction than that entailed in the block secondary type, each section, after impregnation, should be well taped with oiled linen or muslin tape ¾ inch in width. This tape should be cut diagonally from large sheets of the material. If it is cut or torn lengthwise, it will break easily. Varnished muslin cloth, owing to its stiffness, is not well adapted for sharp turns or small diameters.

Oiled muslin has a greater flexibility and longer life under heat conditions, its insulating base being the best quality of linseed oil in which no varnish or drier is used. If bias tape is desired the raw material should be first prepared before going through the insulating process and then cleanly and evenly cut to the width desired, thus eliminating any rupture on the oiled insulating films. This tape may be purchased in the yellow color of oil, although black varnished tape is sometimes used. The average puncture test of oiled muslin is one thousand volts per mil.

Windings should be insulated from the iron to withstand a direct puncture test of 100,000 volts. This can be obtained with ten layers of ten mil cloth. If transformers are to be immersed in oil, it should be pure linseed oil, as inferior oils will do much more harm than good to transformers.

The condensers used in converting the secondary current into a live, effective discharge will differ materially from those used on low voltage sets. The usual descriptions of sending condensers depict a lug of tin foil fastened by shellac between photographic plates. A condenser of this type will actually "burn up" when connected across the secondary of a transformer of over 15,000 volts. Even two sheets of the aforementioned dialectric are insufficient. It is advisable to construct the condenser in units with two plates between each lug and the group of units connected in series multiple. For a one K. W. transformer 200 eight by ten photographic plates, connected in this manner, will suffice.

In using a high voltage transformer, if an ordinary gap is used, it may be of silver, copper, brass, zinc, aluminum or steel, though zinc will be found to give results a trifle superior to the others. The electrodes should be about the size of pencils and rounded at the ends. These electrodes will do for any transformer under five K. W. capacity.

Transmitting loose couplers (oscillation transformers) are not efficient on small aerials. If a helix is used, its diameter should be no less than twelve inches as a smaller diameter will cause the tuning to be too sharp at the receiving end. Commercial companies wind their helices, on sets as low as one K. W., fourteen inches in diameter. This causes the tuning to be coarse even at a great distance which is an important consideration in commercial work. The usual ineffectiveness of amateurs' aerials calls for some counterbalance which is found at least partially in the use of a helix of large diameter. The turns should be spaced over one inch apart and should be well insulated from the wood helix frame by heavy fibre strips.

An efficient set with a good aerial *under all conditions* should cover one mile for every ten watts of energy expended. A ½ kilowatt set should cover 50 miles; a two kilowatt set, 200 miles, etc. Actual tests have proven that most stations will send considerably farther than this under good operating conditions.

Prescription by Wireless

The captain of a tramp steamer in the Gulf of Mexico was taken ill with ptomaine poisoning. With death staring him in the face on account of inadequate medical aid he decided to call, by wireless, for assistance from the physicians at a naval station 100 miles distant. A liner 700 miles farther away heard the wireless call and the ship's surgeon made haste to reply with the necessary prescription which was then filled from the tramp steamer's medicine chest.

Three Slide Tuning Coil

BY A. B. COLE

The three slide tuning coil is preferred to the loose coupled tuner by many experimenters for several reasons. A first-class loose coupled tuner is expensive as compared to the ordinary straight tuner, but is much more selective, enabling the operator to pick out one station from a number, provided that their wave lengths are quite different.

This very selectivity is, however, a disadvantage at times, for if the tuner is set for any one wave length, it is highly probable that signals from a distant station of a different wave length will not affect the detector sufficiently to attract the attention of the receiving operator, and the distant station will have difficulty in making itself heard.

The well known double slide tuner is not nearly so selective as the loose coupled type, and while better adapted to all around work for the reason stated above, is not satisfactory where there is much interference.

The three slide tuning coil combines the advantages of both the above mentioned types, and it can readily be made by the experimenter. It may be well to show how this tuner operates.

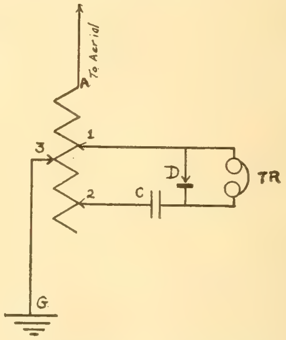
In both the double slide tuning coil and the loose coupled variety we have a number of turns of wire in series with the aerial and the ground, and variation of the inductance of this circuit is accomplished by cutting in or out more or less of the turns of wire, generally by means of a sliding contact.

In both these tuning coils we also have a circuit of variable inductance containing turns of wire on the tuner, the detector, and a condenser. In the case of the double slide tuner, this circuit generally contains turns of wire on the tuner which are common to the aerial, tuning-coil ground circuit, whereas in the loose coupled tuner the detector, tuning-coil condenser circuit includes turns of the secondary winding, which are separated from the primary turns by an air gap.

In both types of tuning coils the inductance of the aerial, tuning-coil ground circuit and that of the detector, tuning-coil, condenser circuit may be varied independently of each other, but in the loose coupled tuner we can also vary the distance between the primary and secondary windings, and thereby effect a greater selectivity.

Referring to the figure, it will be seen that the three-slide tuner acts as both a straight tuner and a loose coupled tuner. The aerial-tuning-coil ground circuit is (A-3-G). The detector, tuning-coil, condenser circuit is (D-1-2-C). The inductance of these circuits can be varied by moving sliding contacts (3), and (2) and (1) respectively. So far we have the general characteristics of the straight tuner.

Beyond the above variation we have another,—that of changing the distance between the two circuits. By leaving slider (3) fixed, and the distance between (1) and (2) constant, it will be observed that the distance between active turns (A-3) and active turns (1-2) can also be varied by moving sliders (1) and (2) down. Thus we combine the actions of the double slide and loose coupled tuning coils and increase efficiency for all around working, for while the three slide tuner is not quite so selective as the loose coupled tuner, it is generally sufficiently so, especially if condenser (C) is variable and of large maximum capacity.



CONNECTIONS OF THREE SLIDE TUNING COIL

It will be found that there is a general position for the sliders, where nearly all stations can be heard, and after a little practice the experimenter will be able to find this without difficulty.

The general position may be found more readily than in the loose coupled tuner because the three slide type is not so selective, as we have stated above, due to the fact that the two circuits are common to the same wire, and not separated by an air gap.

The writer has used this type of tuner for about a year in a location where there is considerable interference, and the results have been very satisfactory.

WIRELESS QUERIES

Answered by A. B. Cole

Questions sent in to this department must comply with the same requirements that are specified in the case of the questions and answers on general electrical subjects. See "Questions and Answers" department.

Location of Aerial; Effect of High Mountain

Questions.—(A) For a station located in a valley, would an aerial 65 or 70 feet high be satisfactory? (B) When electric waves from a wireless telegraph station meet a high mountain, will they pass over it, or will they die out? (C) If my aerial were on the farther side of the mountain could I receive messages from the above transmitting station?—R. J., Vancouver, Can.

Answers.—(A) Yes.

(B) Part of the waves will pass over the mountain and down the other side, and part will be reflected in the same way as would a beam of light thrown against the mountain.

(C) You could receive from the transmitting station, but more sensitive instruments would be needed than if your aerial were located on the nearer side of the mountain, since the reflected energy is lost, as far as your station is concerned.

Lightning Rings Telephone Bell; Aerial and Wireless Waves

Questions.—(A) Why do the bells of a country telephone line ring during a thunderstorm, even if it is at a distance? (B) Are the waves in wireless telegraphy similar (but on a larger scale) to the magnetic lines of force about a conductor or magnet? (C) Explain how an aerial catches or receives these waves. (D) In what way will an aerial assist in sending the waves?—B. C., Fairview, Mo.

Answers.—(A) Because at some point the line is near a place where there is a lightning discharge. If the line is not struck, the ringing of the bells is probably due to its potential being increased, on account of its capacity as a condenser.

(B) Yes, there are two component parts of electro-magnetic waves, the electric and the magnetic. These latter act very much like magnetic lines of force.

(C) The cutting of the electro-magnetic waves by the aerial sets up a current, or oscillations, in the aerial, in the same way as lines of force cutting a conductor set up an electromotive force in it.

(D) The aerial has at least two distinct properties, that of capacity, and that of height. The first allows it to store up a large amount of energy and to radiate it, and the second allows the waves sent out to pass over most obstructions.

Spark Muffler; Use of Ammeter; Anchor Gap

Questions.—(A) What is a "spark muffler"? (B) What is an ammeter used for in tuning, and how is it connected? (C) What is an anchor gap used for?—E. S. W., Plainfield, N. J.

Answers.—(A) A spark muffler consists of a tube of glass or some other insulating material, surrounding the spark gap. The only advantage of having a muffler is that it diminishes the sound of the spark. The spark gap terminals should be cooled as much as possible, and when a muffler is used, it is well to arrange for a circulation of air around the gap terminals, as otherwise they will be heated considerably, and the efficiency of the station will be lowered.

(B) A hot wire ammeter is used to determine when the maximum amount of radiation by the aerial is being obtained, and consequently to show when the transmitting instruments are properly tuned. The meter is connected in series with the helix and aerial, and when a helix is not used, is connected in series with the spark gap and the aerial.

When the instruments are in tune, the reading on the scale of the meter is the highest.

(C) An anchor gap is used wherever it is not desirable to run the high tension currents through the aerial switch. It is used with the loop and umbrella aerials, and prevents the oscillations from passing through the transmitting instruments while receiving.

Wireless and Telephone

Question.—We have a telephone line which is grounded on the same water pipe as our wireless station. When we call up on the telephone and press the key of the wireless set, we can hear the signals in the telephone receiver. What is the trouble?—W. C. A., Chicago, Ill.

Answers.—The telephone line acts as an aerial, and the water pipe is the ground. The carbon grains in the telephone transmitter act as the filings in a coherer. You have, therefore, a wireless outfit in the telephone instrument. There is no way to prevent the disturbance of the telephone line by the wireless set.

Enameled Wire on Tuning Coils

Question.—What is the effect of enameled wire in tuning coils?—H. S. B., Lansing, Ont., Can.

Answer.—A greater number of turns, per inch length of core, can be placed on a coil using enameled wire than when cotton-covered wire is used. Considering two consecutive turns of wire separated by enamel insulation on each wire, we have a condenser effect, the two copper wires acting as conductors, the enamel as an insulator. This condenser or capacity effect acts so as to give a greater wave length per turn of wire on the coil, and since the number of turns per inch of enameled wire is greater than with cotton covered wire, tuning is far less accurate. However, enameled wire has its advantages. The coil needs no further finishing after the wire is in place, the copper wire is hard drawn and so does not wear away so readily under the slider as does the cotton covered soft copper. Lastly, the slider makes a better path for itself through the enamel than through the copper. By reducing the diameter of the coil the capacity effect is somewhat decreased and closer tuning is possible.

Behavior of Wehnelt Interrupter

Question.—I made a Wehnelt interrupter to use in series with a ½-inch spark coil on 110 volts. As soon as I turned the current on I heard a pop and saw a flash, accompanied by a loud buzzing. When I examined the interrupter the platinum wire had disappeared along with the sealing wax which I had used to fasten it in the glass. Can you account for this?—G. B., Washington, D. C.

Answer.—Either there was too much of the platinum wire immersed in the solution, or the percentage of acid in the solution was too great. It may be well to note that German silver wire will give almost as good results as platinum for this purpose. The percentage of acid should be about ten, that is, one part of acid (sulphuric) and nine parts of water.

See article on page 1127.

Aerial Insulation Test; Receiving Current

Questions.—(A) How is a galvanometer used in testing the aerial and lead-in wire insulation? (B) When receiving two miles, how much current is coming through the aerial? When receiving fifty miles?—H. H. K., Wheaton, Ill.

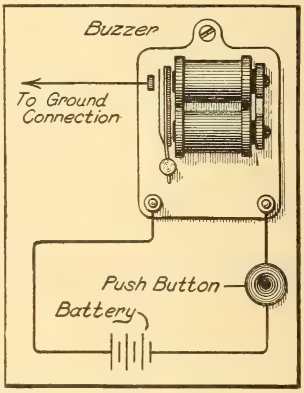
Answers.—(A) Connect the galvanometer in series with two or three batteries, the aerial, and ground, previously disconnecting all instruments from the aerial. The galvanometer should show only a slight deflection. The higher the insulation, the less the deflection.

(B) The amount depends on the power of the transmitting station, the height of both aerials, the methods of connection, and several other factors. In any event, only a small fraction of an ampere is received.

Buzzer Test

Question.—Of what does a buzzer test consist?—F. A. U., Brooklyn, N. Y.

Answers.—This test consists in making use of the electro-magnetic waves set up at the contact points of a buzzer to determine whether the detector is in adjustment or not. The diagram shows the connections. By completing the buzzer circuit by pressing the push button the buzzer is set in operation, and a buzz will be heard in the receivers if the detector is properly adjusted. The more sensitive the detector, the louder the sound.



CONNECTIONS FOR BUZZER TEST

Sensitiveness of Loose Coupled Tuner

Question.—Is a loose coupled tuner with the primary wound over the secondary, the secondary divided into sections, with a slide on the primary, as sensitive as one in which the secondary is drawn out from the primary?—H. F. D., Saratoga Springs, N. Y.

Answer.—No, because one of the essential advantages of the loose coupled tuner is that the primary and secondary can be separated. In an ordinary tuning coil of the single or double slide types, the detector circuit and the aerial-ground circuit are dependent upon each other, that is, if the inductance of one is increased, the inductance of the other is also increased. In the loose coupled tuner, the inductance of these circuits can be varied independently, but for best results, it should also be possible to vary the distance between the windings, thereby varying their mutual inductance.

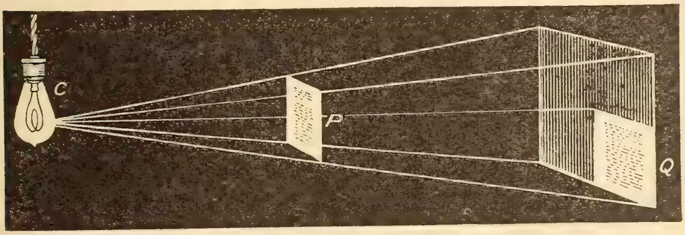
QUESTIONS AND ANSWERS

Use of this department is free to readers of Popular Electricity, but attention will not be given to questions which do not comply with the following rules: All questions must be written in the form of a letter addressed to the Questions and Answers Department and containing nothing for the other departments of the magazine; two-cent stamp must be enclosed for answer by mail, for space will not permit of printing all answers; the full name and address of the writer must be given.

Intensity of Illumination; Mercury Arc Rectifier

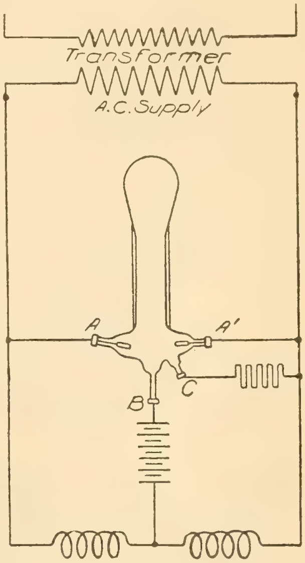
Questions.—(A) A surface 60 feet from a source of light will receive how intense an illumination as compared with the light on a surface 20 feet from the source of light? (B) State briefly the principle of the action of the Mercury Arc Rectifier —F. H. S., Los Angeles, Cal.

Answers.—(A) The intensity of light on a surface varies inversely as the square of the distance of that surface from the source of light. The drawing will help to understand this law. Suppose the distance from a light source (C) to a given surface (P) is 1. Then assume another surface (Q) at a distance 2 from (P). As light travels in straight lines a glance at the drawing, even without a knowledge of geometry, will show that the area (Q) is four times the area (P). If the surface (P) were removed, surface (Q) would receive the same amount of light as (P) received, but this light being distributed over four times the area would be only $\frac{1}{4}$ as intense as on (P). If the surface (Q) were three times as far from (C) as (P) the light would be distributed over an area at (Q) nine times as great. The intensity of illumination would then be only one-ninth as great, and so on, hence the law of inverse squares. Applying the law to the given case in hand, the intensity of light on a surface 60 feet from the source is to the intensity on the surface 20 feet distance as 20^2 is to 60^2. Or in other words is one-ninth as great.



ILLUSTRATING THE LAW OF INVERSE SQUARES

(B) If current is made to flow in one direction between two points through mercury vapor in a glass tube exhausted of air, and the direction of flow be suddenly changed, making what was the negative electrode, positive, the current will cease to flow because mercury displays the characteristic of opposing the change in direction and the formation of a new negative electrode. Using this phenomenon as a basis the mercury vapor rectifier is built on the principle shown in the drawing. There are two electrodes (A) and (A′) entering the tube as shown. Below is a third electrode (B). (C) is simply an arrangement for vaporizing the mercury in starting and is automatically cut out as soon as the tube is in operation. Now the current in the alternating supply wires is constantly



SHOWING THE PRINCIPLE OF THE MERCURY RECTIFIER reversing. Therefore it tends to enter at (A) and leave at (A′) and to enter at (A′) and leave at (A) many times per second. But this it cannot do because of the fact that the current will flow in one direction only through a single electrode as above stated. Therefore the only action which can take place is for one impulse to enter at (A′) and pass down and out at (B). The next impulse, of opposite sign, can not enter at (A′) but does enter at (A), going out also at (B). Therefore we have current flowing out at (B) always in the same direction, or direct current, which is capable of charging a storage battery, as shown, or performing any other work requiring direct current. The two coils down at the bottom of the diagram are choke coils. These choke coils stop alternating current but allow direct current to flow through them. If it were not for these coils a wave coming down and entering (A′), we will say, could also divide and part pass on down and up into the tube at (B), meeting the other part of the divided wave and neutralizing it.

Lamp Circuits

Questions.—(A) How can I wire up a circuit to turn off lights from two points by a switch at each place? For example, I want to turn on a light located at the top of the stairs while I am at the bottom and turn it out again when I reach the top. (B) How may lights be turned on or off from any one of three points?—N. B. K., Erie, Pa.

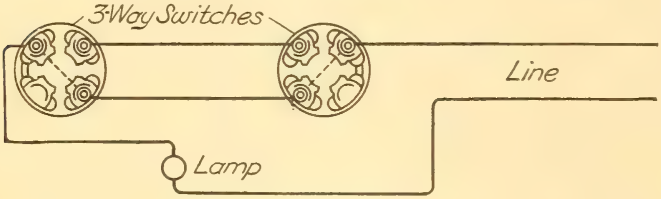


FIG. 1

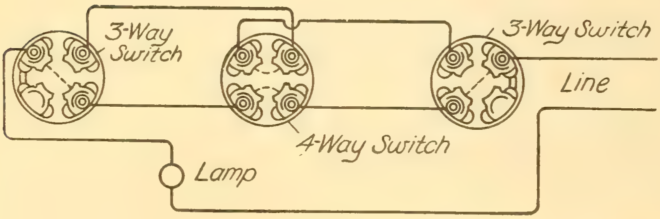


FIG. 2

Answers.—(A) See diagram No. 1.

(B) See diagram No. 2.

Transformer Windings; Alternator and Ampere Turns Defined

Questions.—(A) When winding transformers, must the primary and secondary coils be wound in the same direction? (B) What is an alternator? (C) What is meant by "ampere-turns"?—F. J. S., Etna, Pa.

Answers.—(A) It makes no difference as to their direction with reference to each other. However on a closed core transformer the two parts of the same coil on each leg must be connected so that flux produced by one coil will not oppose the flux produced by the other.

(B) An alternator is a dynamo constructed to generate alternating current.

(C) A term applied to magnet coils and specifying the product of the number of turns of wire multiplied by the number of amperes flowing in the coil. Thus, a magnet wound with a coil of ten turns of wire carrying two amperes would be regarded as affected by twenty ampere-turns.

Underwriters' Rules

Questions.—(A) How many sixteen-candle-power 110-volt carbon filament lamps do the underwriters' rules allow on a branch circuit? (B) On cleat work, how far apart should the cleats be placed? (C) What size fuse plugs should be used on a circuit carrying eleven sixteen-candle-power lamps?

Answers.—(A) The rule reads, "Automatic cut-outs (fuses) must be so placed that no set of incandescent lamps requiring more than 660 watts, whether grouped on one fixture or on several fixtures or pendants, will be dependent upon one cut-out." This rule allows, then, practically twelve sixteen-candle-power, 110-volt, carbon filament lamps upon a branch circuit.

(B) Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every 4½ feet. If the wires are liable to be disturbed, the distance between supports must be shortened. In buildings of mill construction, wires of not less than No. 8 B. & S. gauge, where not liable to be disturbed, may be separated about six inches, and run from timber to timber, not breaking around.

(C) Use six ampere fuses.

Application and Proceedings for Reissue

By OBED C. BILLMAN, L. L. B., M. P. L.

Application and Proceedings Thereon.—*In General.*—The proceedings to obtain a reissue are governed by the rules of the patent office. The application must set forth the facts upon which the right to a reissue is based, and must be accompanied by an oath in conformity to the rules of the patent office. Evidence is admissible in support of the averments of the application. The original patent must be surrendered. In a proper case, the granting of a reissue is a matter of right, the commissioner having no discretion. Where a reissue is improperly refused the applicant has a remedy by bill in equity.

Time of Application.—*In General.*—As a general rule, a patent may be surrendered and reissued at any time during the life of the patent, though the right to a reissue may be lost by unreasonable delay or laches, and the reissue if granted may then be held void.

Delay in Applying for Enlargement of Claims.—A reissue with enlarged claims will not be allowed where there has been unreasonable delay or laches in making the application, especially where in the meanwhile other devices have gone into use which will be affected by such a reissue. Where the error is apparent on the face of the patent, delay in applying for a reissue is especially apt to prove fatal. A delay of more than two years in reissuing in analogy to use prior to the application, requires special circumstances to excuse it, or it will be deemed an abandonment of the new matter to the public. The rule of laches should be strictly applied. Such lapse of time as indicates, under the circumstances, a want of due diligence is fatal, and the reissue if granted is void.

Delay Where Claim not Enlarged.—The correction of a patent by a reissue, where it is involved or inoperative for want of a full and clear description of the invention, is not attended with such injurious results to the public as follows from the enlargement of the claim, and hence a reissue may be proper though a longer period has elapsed since the issue of the original patent. But though a greater degree of diligence is required where the claims are expanded than where they are narrowed or simply made more specific and certain, due diligence is required in all cases.

Reissue in Divisions.—The commissioner may, in his discretion, cause several patents to be issued for distinct and separate parts of the thing patented on demand of the applicant. Thus a patent may be reissued in division for a process and its product. Such divisional reissues are treated as a single patent with several claims.

Identity of Invention in Original and Reissued Patents—Necessity of Identity.—The statute only authorizes a reissue for the same invention as the original patent. Accordingly, a reissued patent for a different invention is void.

New Matter in Specification—amendment.—By express provision of the statute no new matter may be introduced into the specification of the reissued patent. Nor, in the case of a machine patent, may the model or drawing be amended, except by each other. But when there is neither model nor drawing, amendments may be made upon proof satisfactory to the commissioner that such new matter or amendment was a part of the original invention, and was omitted from the specification by inadvertence, accident, or mistake. The power to surrender and reissue patents implies that the specification may be corrected to cure the defect and supply the deficiency.

What Constitutes Identity.—*Questions for Court and Jury.*—Whether or not the reissued patent is for the same invention as the original patent is ordinarily a question of fact for the jury. But whenever the question can be determined solely from the face of the patents by mere comparison, without the aid of extrinsic evidence to explain terms of art or to apply the descriptions to the subject-matter, it is one of law for the court.

In an equity case the question may always be determined by the court.

Inclusion of Disclaimed, Rejected, or Abandoned Matter.—A reissued patent cannot be sustained where it contains claims that have once been formally disclaimed by the patentee, or have been rejected and he has acquiesced in such rejection in order to obtain his patent. Claims for matter clearly included in the original application and subsequently abandoned cannot be included in a reissue. But if a disclaimer, withdrawal, or abandonment of a feature of the original invention was caused by mistake or error of the patent office, such features may be included in a reissue.

Enlargement of Claims.—It is well settled that upon reissue the specification cannot be substantially changed so as to enlarge the invention as intended to be originally claimed. But, as has been seen, this does not prevent the reissue of a patent with claims broader than the claims of the original patent, where such original claims were too narrow to cover the actual invention made and intended to be claimed. But what is dedicated to the public by description and failure to claim in the original cannot be claimed in a reissue. Where a claim has been limited by amendments in the patent office it cannot be afterward broadened by reissue of the patent.

Narrowing Claims.—The inventor is always at liberty in a reissued patent to omit a part of his original invention, thereby dedicating it to the public.

Substitution of Equivalents.—The substitution of equivalents will not be permitted in a reissue, except, perhaps, in such a clear case that the court could decide as a matter of law that the ingredient substituted is an equivalent for the one withdrawn, and was well known as such at the date of the original patent. In any case, however, it is held that the substituted device should be alleged to be an equivalent of the one stricken out.

Combinations.—An original combination claim reissued for a greater or less number of parts is void because not for the same invention. So a reissue claiming the elements separately and not as a combination is void, as is a combination of different or new elements. But sub-combinations may be claimed on reissue.

Machine, Process and Product.—A patent for the invention of a machine cannot be reissued for the purpose of claiming a process or a product, or *vice versa*, because not for the same invention. But if one is the result of the other, and they are so related that the invention of one involves the invention of the other, it seems that a failure to claim all may be cured by reissue.

NEW BOOKS

STORAGE BATTERIES. By A. E. Watson. Lynn, Mass.: Bubier Publishing Company. 1911. 160 pages with 63 illustrations. Price $1.50.

In this work the author has aimed to cover the theory, construction and use of storage batteries in a brief but clear way so that the man who is not acquainted with the subject is able to find out what he wants to know without assistance. The lead cell is the basis of the treatise, modern cells of various makes being described. A chapter is devoted to "How to Make," and one to "Switchboard Arrangements," while all the essential facts which the practical man looks for have been given consideration.

MANAGEMENT OF DYNAMOS. By G. W. Lumis-Patterson. New York: Norman W. Henley Publishing Company. 1909. 285 pages with 117 illustrations. Price, $2.00.

This book was first published thirteen years ago. The present (fourth edition) has been brought up to date by eliminating descriptions and illustrations of obsolete types of apparatus. Present day machinery is illustrated and described. The volume is prepared with a view to meet the wants of mechanics, engineers, students and others who may have to know about or care for dynamos. After explaining the principles of electricity and magnetism the book sets forth their application in the dynamo, helping the dynamo tender by giving space to such subjects as: "Shutting Down Dynamo," "Freeing Commutator," "Failure to Excite," "Erecting Dynamos," etc.

WINDMILLS AND WIND MOTORS. HOW TO BUILD AND RUN THEM. By F. E. Powell. New York: Spon and Chamberlain. 1910. 78 pages with 76 illustrations. Price, 25 cents.

The author has endeavored to interest all classes of readers in his subject. The book treats on the construction of small windmills for pumping water, generating electricity, or driving small machines. An American type windmill, diameter of sails three feet, is described; also a small working windmill large enough to drive a 30-watt dynamo, and later a 10-foot mill rated by the author to develop $\frac{1}{4}$ horsepower in a 16-mile breeze. The final chapter treats on "Production of Electricity by Wind-power."

ON POLYPHASE SUBJECTS

Index to Volume III

A great many of the regular subscribers to Popular Electricity keep all the numbers and bind them up in a volume at the end of the year. To them a comprehensive index of the contents of the twelve numbers is of great value in using the magazines for reference. It has been our custom in the past to print such an index and one will be printed this year for Volume III. Previously, every subscriber received an index with the last number of each volume (April issue). But our mailing list has become so large, and the index this year being more voluminous than ever, it seems a pity to send out so many thousands when a certain percentage will be wasted on those who do not make a practice of keeping back copies

Therefore we are going to ask those who desire an index this year to write and ask for it, inclosing a one-cent stamp to pay the postage. A sufficient supply will be printed to meet the requests. The index will be ready about April 1st.

On Questions and Answers

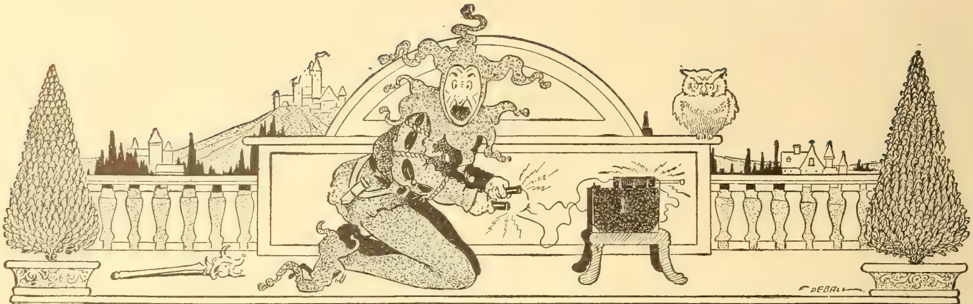
From the very beginning it has been our policy to answer the questions on electricity which our readers may ask. The Question and Answer Department we believe to be one of our most important aids in making friends for the magazine. But the business of answering questions is not altogether holiday work and we cannot refrain from unbosoming to those who make use of the service some of the troubles which it brings to us.

As we have explained before, the number of questions answered in the magazine is small in comparison to the number we answer by mail. Every day brings scores of letters of this sort, all of which are taken care of if they comply with the regulations printed at the head of the Question and Answer Department. This is done at a heavy expense. We ask in return that those who ask questions make our work as easy as possible. State your questions as concisely as possible and try to limit the number to a reasonable extent. Some go so far as to ask a dozen to fifteen questions in a string, carelessly written with a lead pencil on both sides of several sheets of paper. Try to bear in mind that it is hardly fair to us to sit down and dash off a lot of questions that we have repeatedly answered in the magazine or the answers to which you could easily obtain from some elementary book to which, likely as not, you have access.

Do not ask foolish questions. The other day we received a letter in which the writer calmly asked us to tell him how to build a submarine. If he had expended one-tenth of the energy in thinking that he did in writing the letter he would have realized that our Question and Answer Department could not be expected to furnish plans for submarines, warships, skyscrapers and kindred objects—especially for the price of a two-cent stamp.

Still others send letters asking for an immediate answer but forget to give their name and address. These letters are referred to "no address" file. Shortly we receive an inquiry sometimes quite emphatic asking why we do not answer. Relieved from embarrassment we reply after consulting the "file of mystery." Don't fail to let us know who you are and where you live.

It is our desire to do all in our power to assist our readers who are interested in and making a study of electricity. We want them to feel free to come to us when they are really "up against it," to use a slang expression which seems to fit the case. In return we feel that it is only fair that they should take the pains to try and dig out the information for themselves first and only come to us as a last resort. When it is really necessary to write, the questions should be as few as possible to cover the point, they should be clearly stated, they should be neatly and legibly written on one side of the sheet and this sheet should be mailed, care of the Question and Answer Department without containing anything for other departments, and with a two-cent stamp included.



SHORT CIRCUITS

Just before the boat left on its return trip, a big, rosy German came straggling down the pier to the ticket gate.

"Ticket, please," said the keeper.

"I don't got a teckit—I'm der drummer mit der band," replied the German.

"But you must have a ticket."

"Veil, I hat one but I loose him."

"You must have it, I tell you," persisted the gatekeeper; "you couldn't lose it."

"Vat!" shouted the bandman. "I couldn't loose dat little teckit? Mein Gott! I haf loose my bass-drum!"

* * *

She was a beautiful statuesque blonde who had changed her residence from New York to Philadelphia and secured a position as stenographer in the office of a staid, dignified citizen of good old Quaker descent. On the morning of her first appearance she went straight to the desk of the boss.

"I presume," she remarked, "that you begin the day over here the same as they do in New York."

"Oh, yes," replied the boss, without glancing from the letter he was reading.

"Well, hurry up and kiss me, then," was the startling rejoinder. "I want to get to work."

* * *

A young person of Tomahawk Bluff
Carried pistols to make him look tough.
When they asked "Do you chew?" he replied,
"Yes, I do,
I'm a wegular wetch of a wough."

* * *

"Now, Johnny," said the Sunday-school superintendent, "can you tell me what it was that caused the prophet Elijah to go up?"

"Yeth, thir," said Johnny, 'it wath the Payne tariff bill."

* * *

Two Peoria women boarded a street car the other day and sat opposite each other in perfect silence. Both wore the wastebasket style of hat. They rode downtown oblivious of each other's presence and got off at the same corner. The first looked up as she descended and gave a start of surprise.

"Why, is that you dear?" she exclaimed. "I wondered who is was, but I didn't recognize your feet."

* * *

"Why does a dog hang his tongue out of his mouth?" asked the teacher.

"Yes, my boy," he said to a bright looking lad who held up his hand, while the light of genius was in his eye.

"To balance his tail!" shouted the bright boy.

* * *

"That nephew of yours is a little wild, I'll admit," said Uncle Jerry's neighbor, trying to comfort him, "but he'll reform as he grows older. Leave him to time and nature."

"Time and nature!" snapped Uncle Jerry. "It's time and nature that make Limburger cheese what it is."

Artist—"Madam, it is not faces alone that I paint it is souls."

Madam—"Oh, you do interiors, then?"

* * *

Rastus: "For the love of heben, Sambo, what fer you got you 'alls pants turned wrong side beforemos'?"

Sambo: "Sh! Don't talk so loud. You see, I's invited to a swell reception to-night and I's gettin' de bulge out'n de knees."

* * *

Opie Read, the novelist, appeared as entertainer for a switchman's convention in Peoria.

"It was a very enthusiastic audience," said Mr. Read. "They laughed heartily, but they didn't applaud much. You see there were so many one-armed men there, that they had to applaud in pairs."

* * *

In the first act he tied the beautiful heroine to a railroad track just as the limited was due. In the second, he lured her into an old house, locked her in an upper room and set the place on fire. In the third, he strapped her under a buzz saw and set the machinery in motion.

In the fourth act he started to make love to her. She shrank from him.

"Why do you fear me, Nellie?" he asked.

* * *

A man looking for a position was walking along the banks of a river when he heard cries for help. He stopped, and found it to be a friend of his who was employed in a nearby factory. The man was about to save his friend, when a quick thought came to him, and he said:

"No, I'll get his job." So he went to the factory and said to the manager, "I came to apply for the position of the man If just saw drowning." "You are just five minutes too late," said the manager; "the man that pushed him in was here first."

* * *

Stubbs was feeling his way to the kitchen range in the dark, when he fell over the coal scuttle.

"Oh, John," called Mrs. Stubbs, sweetly, "I know what you need You should get what they have on battleships."

"What's that?" growled Stubbs, as he rubbed his shins.

"Why, a range finder."

And what Stubbs said about woman's wit was plenty.

* * *

"Say, Waiter, that lobster is without one claw. How's that?"

"You see, sir, they're so fresh, those lobsters, they fight with each other in the pantry."

"Well, take that one away and bring me the winner."

* * *

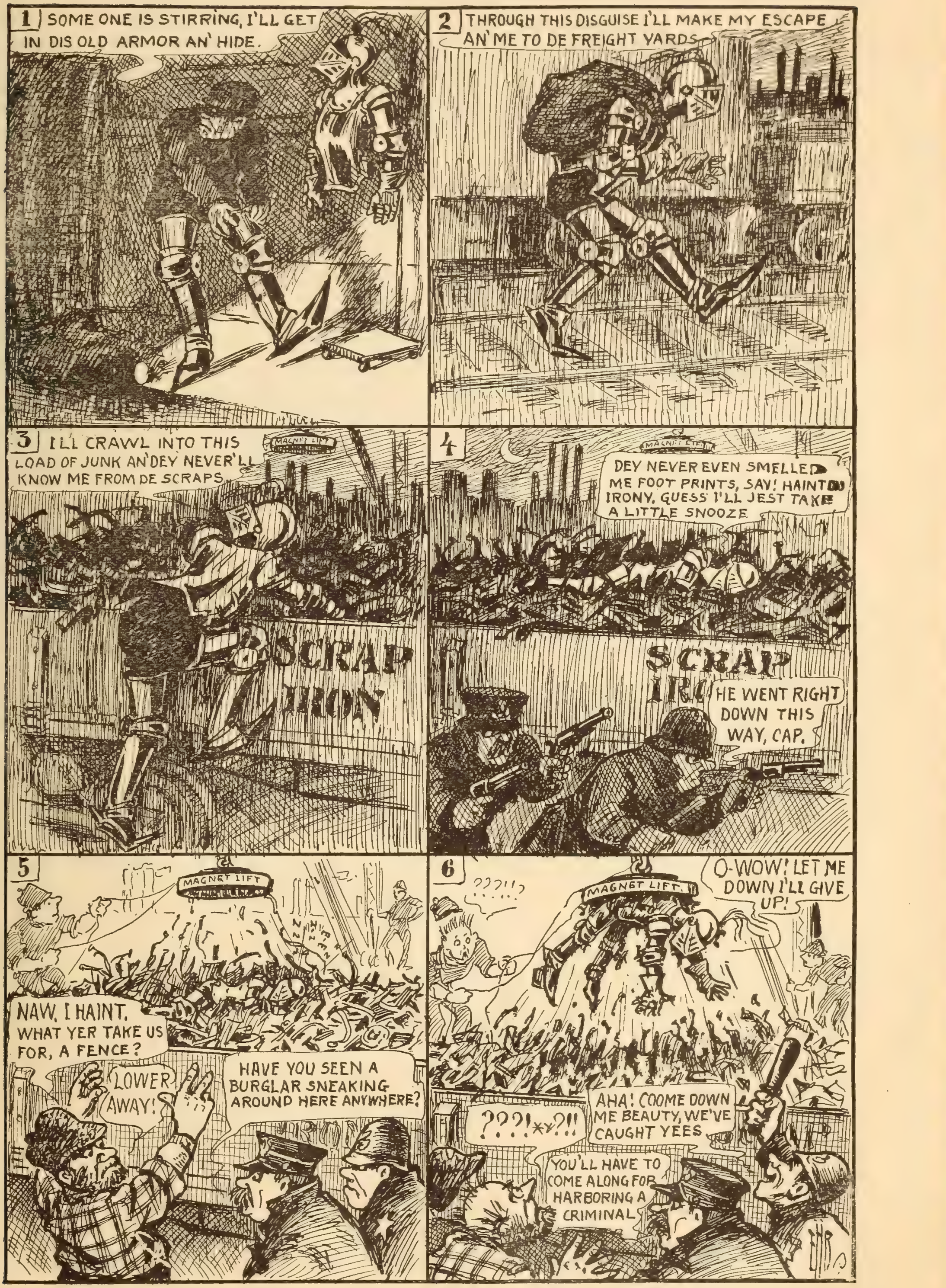
"It was Satan," said a mother to one of her children, 'who put it into your head to pull Elsie's hair."

"Perhaps it was," replied the little girl, "but kicking her shins was my own idea."

* * *

A girl who was wearing a hobble,
While carefully treading the "cobble,"
Dropped her new diamond brooch,
But she just couldn't "scrooch,"
And a gutter snipe captured the bauble.

The Magnetic Burglar


1
SOME ONE IS STIRRING, I'LL GET IN DIS OLD ARMOR AN' HIDE.
2
THROUGH THIS DISGUISE I'LL MAKE MY ESCAPE AN' ME TO DE FREIGHT YARDS
3
I'LL CRAWL INTO THIS LOAD OF JUNK AN' DEY NEVER'LL KNOW ME FROM DE SCRAPS
MAGNET LIFT
SCRAP IRON
4
MAGNET LIFT
DEY NEVER EVEN SMELLED ME FOOT PRINTS, SAY! HAINT [illegible] IRONY. GUESS I'LL JEST TAKE A LITTLE SNOOZE
SCRAP IRO
HE WENT RIGHT DOWN THIS WAY, CAP.
5
MAGNET LIFT
NAW, I HAINT. WHAT YER TAKE US FOR, A FENCE?
LOWER AWAY!
HAVE YOU SEEN A BURGLAR SNEAKING AROUND HERE ANYWHERE?
6
MAGNET LIFT.
???!!?
O-WOW! LET ME DOWN I'LL GIVE UP!
???!**?!!
AHA! COOME DOWN ME BEAUTY, WE'VE CAUGHT YEES
YOU'LL HAVE TO COME ALONG FOR HARBORING A CRIMINAL
EHR

COMMON ELECTRICAL TERMS DEFINED

In this age of electricity everyone should be versed in its phraseology. By studying this page from month to month a working knowledge of the most commonly employed electrical terms may be obtained.

CONTROLLER.—A device operated by the motorman of an electric car by means of which the motor is controlled, resistance being cut in or out of the circuit. In the Thomson-Houston system of automatic regulation of current, a magnet controlled by the main circuit current, thus operating with every change of strength of current and so keeping this current practically constant.

CONVERTER.—A term sometimes used instead of transformer.

CO-PHASAL ALTERNATIONS.—If two alternate current generators are "in step" their alternations are co-phasal.

CORED CARBONS.—An arc lamp electrode having a center of charcoal or soft carbon around which is moulded hard carbon.

COULOMB.—The quantity of current that would pass in one second through a circuit of one ohm resistance and under a pressure of one volt. Called after the scientist of that name.

C^2R LOSS.—An expression for the loss of energy of a current passing through a conductor, this loss being due to the fact that the conductor offers a resistance. The expression is derived as follows: The number of watts flowing in a circuit equals the current times the volts or $W = C \times E$. But from Ohm's law $E = C \times R$. Substituting for E, $W = C \times C \times R = C^2R$, watts lost.

COUNTER ELECTROMOTIVE FORCE.—A voltage or pressure opposed to the main voltage in a circuit. A motor develops counter electromotive force which opposes to a certain extent the voltage impressed upon the motor. In the electrolysis of water, one electrode becomes covered with bubbles of hydrogen, the other with bubbles of oxygen; this creates a counter E. M. F. of polarization. In the carbon arc the heating differentially of the two carbons develops counter E. M. F.

COUNTER INDUCTIVE EFFECT.—A current produced in a second circuit by induction from the first, this second current opposing the regular flow of current in the first.

COUPLE.—Used in electricity to designate a galvanic or voltaic cell consisting of two electrodes and one or two liquids. The Daniell cell is an example.

C. P.—An abbreviation for candle-power. Also applied instead of the words "chemically pure" with reference to chemicals used in electric batteries.

CRATER.—The hollow in what is usually the upper or positive carbon in the arc lamp. This crater emits most of the light and averages .04 inch deep by .2 inch across. This is the hottest part of the arc and attains a temperature of approximately 3500° C.

CREEPING.—The solution in a battery jar will always rise a little above the level of the liquid, evaporation takes place and the salt dries on and affords a path for more of the solution to "creep" through it. This action, termed "creeping," continues until a layer of the salt is formed up over the edge of the vessel. To prevent creeping paraffine may be applied to the edges of the jar or oi may be poured over the battery solution.

CRITICAL CURRENT.—The current produced by a dynamo at what is called its critical speed which if varied slightly causes a great difference in the voltage.

CRITICAL RESISTANCE.—That resistance of the external circuit of a series wound machine which if raised beyond a certain point will cause the machine to refuse to excite itself.

CRITICAL VOLTAGE.—Used in wireless telegraphy to denote the voltage at which a detector commences its action. In an electrolytic detector it is the voltage at which the thin film of gas that collects on the "bare point" breaks down.

CROOKES' DARK SPACE.—If an electric current is caused to pass through an exhausted tube provided with electrodes, the space about the negative electrode is dark, this darkness going farther into the tube as the vacuum is increased. If the vacuum be made very high the dark space will extend almost the entire length of the tube.

CROSS ARM.—A cross piece of wood or iron fastened horizontally to a telegraph, telephone, or light and power pole to support insulators and wires.

CROSS-MAGNETIZING EFFECT.—The current flowing in the armature of a dynamo or motor develops lines of force approximately perpendicular to those from the field poles. The resultant of these two sets of lines is a somewhat distorted field between the poles.

CROSS-OVER.—A device used where two trolley car lines cross each other to prevent the trolley from jumping off the wire and from arcing.

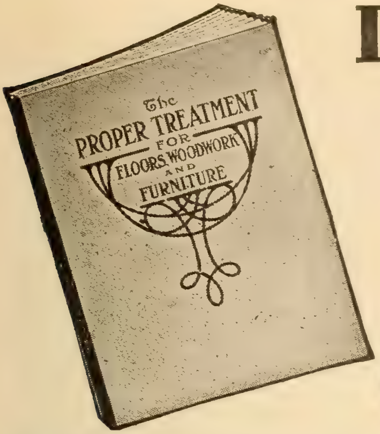
CROSS TALK.—A transfer of current between two or more telephone circuits by induction or crossed wires so that conversation intended for one line is heard upon another line or lines.

CROWFOOT BATTERY.—See Battery. Gravity,

CRUCIBLE, ELECTRIC.—A crucible in which the heat produced by an electric arc is used to obtain high temperatures in reducing ores, forming alloys and performing difficult fusions.

CRYSTAL DETECTOR.—A device used in wireless telegraphy for rectifying the electrical oscillations or Hertzian waves that the aerial gathers, enabling them to pass as an electric current through a telephone receiver in which they produce sound. The detector consists of two crystals so held as just to touch each other, or of one crystal and a metallic point lightly adjusted to its surface. The crystals used belong principally to the carbon and sulphur groups and have the peculiar property of passing current better in one direction than in the other. Some of the more common crystals are: Carborundum, fused silicon and iron pyrites.

CURRENT.—A term used to designate the transference of electrical energy from one point to another over or through a conductor. A rough analogy is to liken it to the flow of water through a pipe connecting two tanks of different level.



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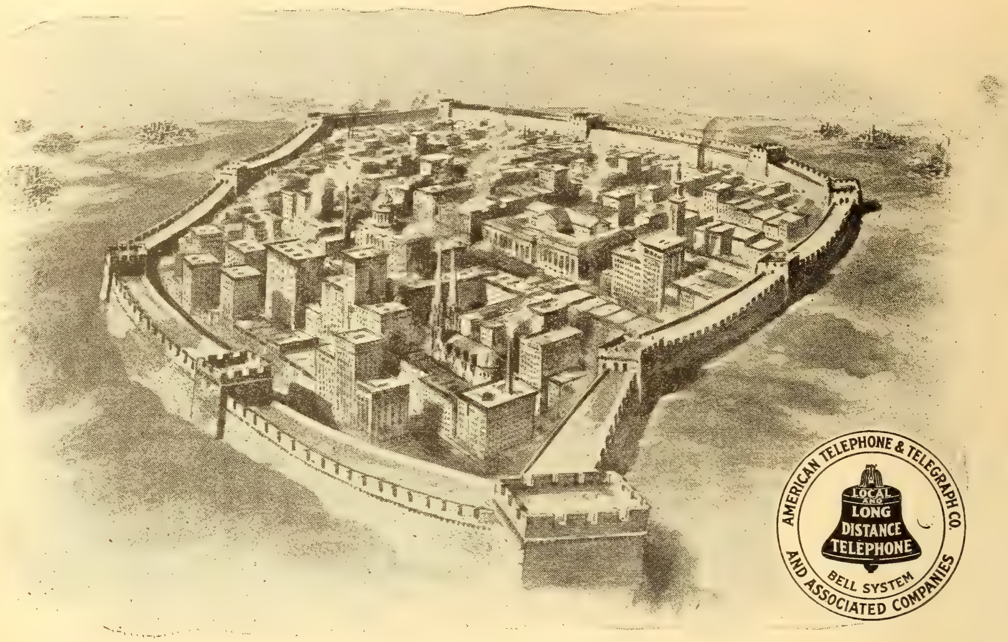
S. C. Johnson & Son, *"The Wood Finishing Authorities"* **Racine, Wis.**


AMERICAN TELEPHONE & TELEGRAPH CO.
LOCAL AND LONG DISTANCE TELEPHONE
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A MEDIAEVAL CONDITION

Telephone Service— Universal or Limited?

TELEPHONE users make more local than long distance calls yet to each user comes the vital demand for distant communication.

No individual can escape this necessity. It comes to all and cannot be foreseen.

No community can afford to surround itself with a sound-proof Chinese Wall and risk telephone isolation.

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Each telephone subscriber, each community, each State demands to be the center of a talking circle which shall be large enough to include all possible needs of inter-communication.

In response to this universal demand the Bell Telephone System is clearing the way for universal service.

Every Bell Telephone is the Center of the System

AMERICAN TELEPHONE AND TELEGRAPH COMPANY

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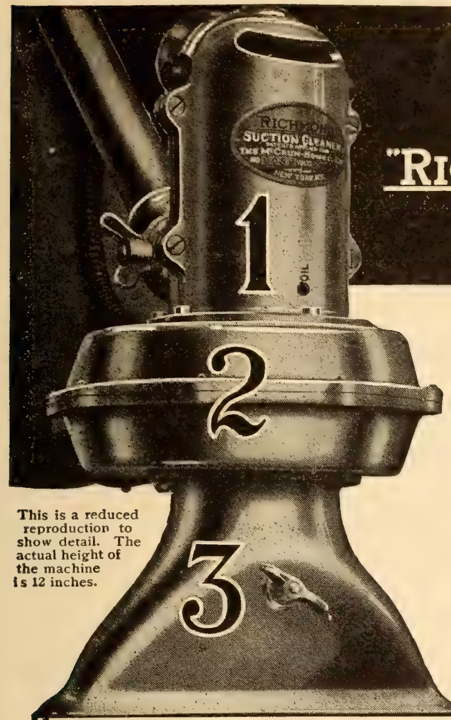
One Dollar

Puts the "RICHMOND" Suction Cleaner in Your Home



This is a reduced reproduction to show detail. The actual height of the machine is 12 inches.

ONE Dollar forever frees you from brooms, mops and dusters—and the backaches and drudgery they bring.

One Dollar forever stops the expense and the nuisance of Spring and Fall housecleaning.

One Dollar enables you to do, *easily*, by electricity, the *worst work* a woman has to do.

And One Dollar is the only cash outlay.

It will bring you the "RICHMOND" Suction Cleaner complete—ready for instant use.

The balance you pay for month by month out *of the actual money you save.*

For Vacuum Cleaning is the greatest of all household economies.

You are paying the price of a suction cleaner, *right now*—whether you have one or not.

You are paying its price out in twice-a-year house cleaning alone—for a "RICHMOND" makes housecleaning needless.

You are paying its price out—many times over—in the hard labor of sweeping and dusting which the "RICHMOND" makes unnecessary

You are paying its price out again and again in the damage which dust does to your furniture, to your carpets, to your hangings, to your clothing—to YOU.

You are paying the price of a "RICHMOND" when a single dollar would save the waste.

YOU see here the lightest and simplest suction cleaner *ever designed.*

1.—is the motor—not a "stock" motor, but one built expressly to operate the powerful suction fan to which it is directly connected, under

2.—a suction fan which embodies the best of all that was learned in two years of steady, scientific experiment.

3.—is the suction nozzle which is pushed over the surfaces to be cleaned—or to which can be attached a twelve-foot hose for high wall, drapery and upholstery cleaning.

The "RICHMOND" Suction Cleaner enables you, now for the first time, to clean by electricity without lugging a 60 to 80 pound machine from room to room—upstairs and down.

It represents as great an advance over heavy weight vacuum cleaners as these cleaners represented over brooms and carpet sweepers.

But light weight and easy operation are but two of the "RICHMOND'S" exclusive superiorities. There are many more.

The vibrating brush, which taps the caked dirt out of otherwise uncleanable rugs and carpets—the hair-drying and pillow-renovating attachments—the seven special tools which make the 'RICHMOND" the most complete cleaner ever offered.

Manufactured exclusively for the RICHMOND SALES CO. by

THE McCRUM-HOWELL CO.
103 Park Ave. and 41st St., New York
Five Factories: Two at Uniontown, Pa.--One at Norwich, Conn.
One at Racine, Wis.---One at Chicago, Ill.

MANUFACTURERS OF "RICHMOND" Boilers and Radiators, "RICHMOND" Enameled Ware, Bath Tubs, Sinks, Lavatories, "RICHMOND" Suds Makers, "RICHMOND" Concealed Transom Lifts, and "RICHMOND" Stationary Vacuum Cleaning Systems

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Limited Offer

The Dollar Offer is limited. It is made to show our unbounded confidence in the "RICHMOND"

But by its very liberality, it is bound to swamp the factory. And when the limit of factory output is reached, the offer must be withdrawn.

So send the coupon today while the opportunity is still yours! Don't wait. Do it NOW.

THE RICHMOND SALES CO.
Dept. 74, 103 Park Ave. New York

DOLLAR COUPON

THE RICHMOND SALES CO., Dept. 74, 103 Park Ave., N. Y City

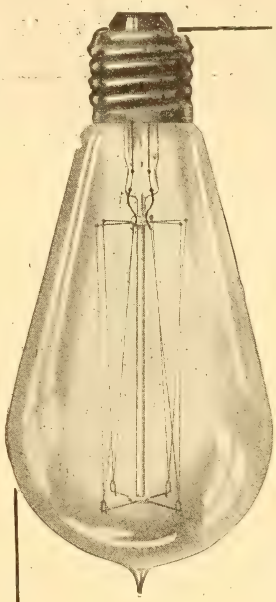
I hereby order one "RICHMOND" Suction Cleaner, complete with the following attachments:

1 Hose Attachment Shoe
1 12-ft. covered Suction Hose
1 Book and Wall Brush
1 10-in. Drapery Tool
1 3-in. Suction Tool
1 Felt-Faced Floor Tool
1 Adjustable Wall Brush
1 30-ft. Electrical Cord
1 Complete Hair Drying Attachment

—for which I agree to pay to your order, $1.00 herewith, and $6.00 on the first day of each of the next 12 consecutive months. Title to be given me when full amount is paid.

Name..

Address..



The *Mazda Lamp* may be *substituted* for *any electric bulb* which you are now using, with these results:—

Saving in Electric Current
Increasing Beauty and
Value of Light

These lamps will fit any socket and burns at any angle; they produce 2½ times the light of an ordinary electric lamp.

Electric light is now cheaper than any other practical illuminant. Cleanliness and healthfulness, beauty and safety are four characteristics possessed by electric light in greater measure than any other illuminant. Electric light is most desirable; *it is least expensive* now that the Mazda Lamp cut the cost of electric light to less than half its former prices. Electric lighting will increase the value and comfort of your home.

Use Mazda Lamps and have all the light you want at no increased expense. Your lighting company or the nearest electrical dealer can supply you with these lamps. Stop in and discuss the lamp and its performance with them and try one lamp in your home.

National Electric Lamp Association
CLEVELAND

Wire your house with the *money YOU SAVE by using electric lights.* You may save money by using electric light because the Mazda lamp has reduced the cost of electric light by producing three rays of light where only one was produced before with the old style lamp.

Your lighting company will make you a wiring proposition and will demonstrate just how and why the Mazda lamp is most economical and efficient.

The Member Companies of the National Electric Lamp Association listed below, each manufacture Mazda lamps and maintain the highest standard of lamp quality set by the Engineering Department of that Association.

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THE BRYAN-MARSH COMPANY, Chicago, Ill.
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THE BUCKEYE ELECTRIC LAMP CO., Mexico City, Mexico
THE CLEVELAND MINIA. LAMP CO., Cleveland, O.
THE COLONIAL ELECTRIC CO., Warren, O.
THE COLUMBIA INC. LAMP CO. St. Louis, Mo.
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THE MONARCH INC. LAMP CO., Chicago, Ill.
NEW YORK & OHIO COMPANY, Warren, O.
THE SHELBY ELECTRIC CO., Shelby, O.
THE STANDARD ELECTRICAL MFG. CO., Warren, O.
SUNBEAM INC. LAMP CO., Chicago, Ill.
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National Electric Lamp Association

CLEVELAND

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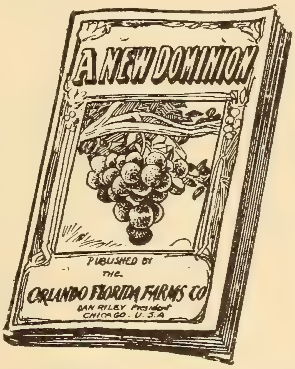

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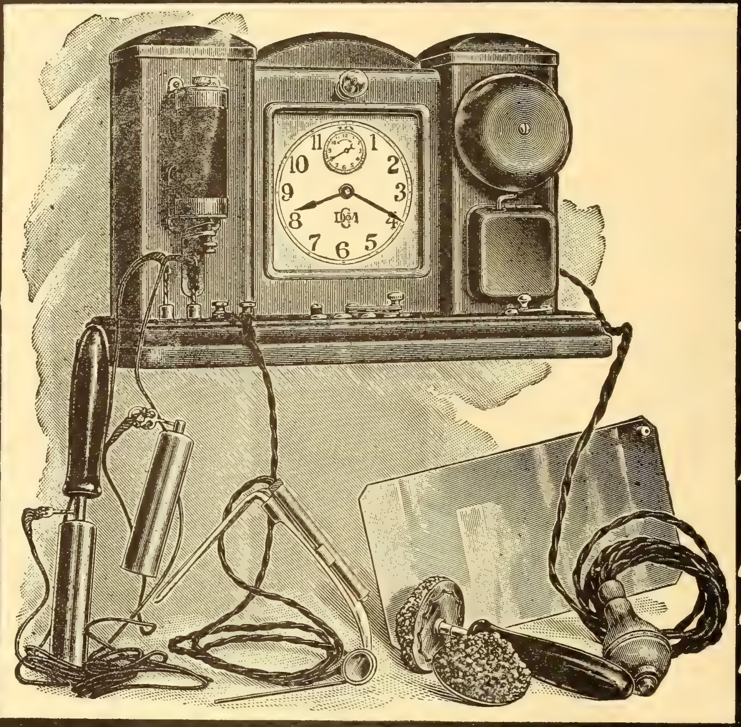

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Mechanical Draftsman
R. R. Constructing
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Architect
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Architectural Draftsman
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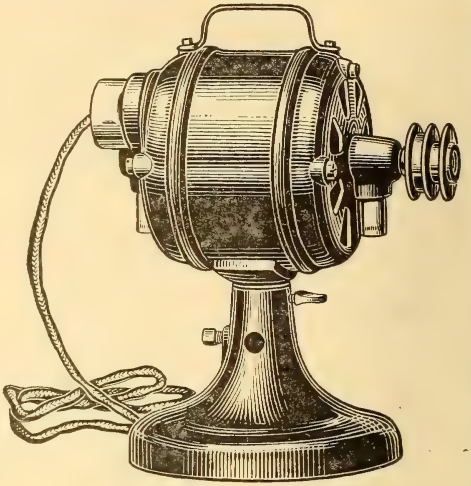
*Name*______________________________

*St. & No.*______________________________

*City*____________________ *State*__________

Present Occupation ______________________

You Turn on Electric Power Simply as You Turn on Electric Light With This Motor



JUST enough power to put an edge on tools—to run a lathe, a jig-saw, a sign-flasher, any light machine—to do ordinary buffing—to run a direct connected blower which will exhaust when reversed—to operate a sewing machine. All these things and more with one single motor

The Westinghouse General Utility Motor

Offices homes and small shops that are wired for electric current are installing them for many duties requiring moderate power. Different inexpensive attachments are used to do the various kinds of work. You only need invest in the motor and the attachment you require.

Costs very little to operate and so well built that it lasts and does its work a lifetime. May be attached to any electrical connection. No trouble and no care. Price $18.25 upward according to attachments.

Go see it work. Call on your lighting company or a dealer in your neighborhood and ask for a demonstration. If he is unable to show it write us and we will send you full description and tell you a dealer to go to. Address Westinghouse Dept. of Publicity, Pittsburg.

Westinghouse Electric & Manufacturing Company
PITTSBURG

Sales Offices in 40 American Cities **Representatives All Over the World**

The Right Kind of Heat for Chilly Spring Days is Electric Heat

Altho many spring days are bright and cheery, the mornings and evenings are usually too chilly for comfort. Just enough heat is needed, *at the right time,* to drive away dampness and cold.

For centuries the Orientals and Europeans have used charcoal braziers for this purpose. But Americans need be content with nothing less than an electric portable radiator.

A Portable Luminous Electric Radiator

For bathroom, nursery, library, dining-room, office—anywhere there is an electric light socket—a turn of a switch will produce instantly a cheerful warm glow from a radiator that requires no watching.

The bright luminous rays of heat are like summer sunshine.

With *electric* radiators there are no dirt, gases or odors; no oxygen consuming flames; no fires to build; no ashes to remove; above all, *no danger*.

This electric radiator can be seen in the show rooms of your lighting company or electrical supply dealer. Prices are reasonable.

General Electric Company

Largest Electrical Manufacturers in the World
Dept. 30, Schenectady, N. Y.
Sales Offices in all Large Cities

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30 Days Free Trial

$1 a Week

FOR THE ARTISTIC

Meister Piano

SOLD DIRECT FROM FACTORY TO YOU

NO CASH DOWN NO INTEREST
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Price $175.00

STOOL AND SCARF FREE

A guaranteed saving of $100 at least on each instrument

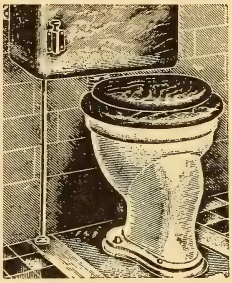
We believe the correct way to buy a piano is to try it in your own home first. We don't want the trial to cause you any expense, hence we pay the freight—also the return freight if the piano is not entirely satisfactory.

Notwithstanding our easy terms of payments, *and our extremely low prices*, the Meister is a high-class instrument of standard construction and quality, fully guaranteed for 10 years. Ask your local banker to investigate our standing. Rothschild & Co's. resources exceed $3,000,000.00.

We sell more pianos direct from factory to home than any other concern in the world

SEND A POSTAL FOR THE PIANO BOOK
It is FREE, and illustrates in the colors of the wood eight styles of the Meister.

THE MEISTER PIANO CO.
Rothschild & Co., sole owners
State, Van Buren and Wabash Ave.
Dept. 20E
CHICAGO, ILL.



$11.50 FOR THIS

Lowdown Washdown Combination

The best and most sanitary closet on the market. Deep seal syphon action washdown vitreous china bowl, solid oak, copper lined tank, seat attached to bowl with nickel-plated hinges, brass nickel-plated supply pipe and two inch flush connection.

35 to 70% Saved on Everything in Plumbing and Heating

Iron enameled kitchen sink, sink and back cast in one piece	$9.00
Porcelain-enameled lavatory, complete with nickel-plated faucets, and nickel-plated trap	$7.00
Complete three-piece porcelain enameled Bath Room outfits	$24.95

Complete Water System for Country Homes

Write for Catalogue No. 11 today—It's a money saver.

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Established 1876
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The Recessed Steel Medicine Cabinet

The Only Modern, Sanitary STEEL Medicine Cabinet

or locker finished in snow-white, baked everlasting enamel, inside and out. Beautiful beveled mirror door. Nickel plate brass trimmings. Steel or glass shelves.

Costs Less Than Wood

Never warps, shrinks, nor swells. Dust and vermin proof, easily cleaned.

Should Be In Every Bath Room

Four styles—four sizes. To recess in wall or to hang outside. Send for illustrated circular.

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In your neighborhood for the

New York Vacuum Cleaner

"The Cleaner That Cleans"

We want men and women to use, exhibit and demonstrate in their own homes this remarkable cleaning device —who will show their friends, acquaintances and neighbors the lightest, most powerful, durable and economical Suction Cleaner made; who will explain how it lightens housework, improves the sanitary condition of the home, how it pays for itself many times in the course of a year.

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Now, at House Cleaning Time, is one of the best seasons. Write to-day for catalogue, booklet and full information, and secure this money-making opportunity for youself.

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505 Marbridge Building
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Such an Opportunity may not come your way again

Many of our agents are making from $30 to $60 a week.

Our New Jersey factory is one of the largest and most complete of its kind in the world. We can manufacture cheaper and better. Our agents get the benefit.

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Many storekeepers are making big profits from handling our Cleaners. Hand Power Cleaners retail at $15.00.

We make the best hand power cleaners—the best electric cleaners.

Remember—There will be **but one** agent in your neighborhood, so you should write **now,** to-day.

HESS Sent on Approval **FURNACE**

No. 45 "Leader" Hess Steel Furnace Price $49
Delivered East of Omaha and North of Ohio River
Pipes and Registers Extra

We will deliver a complete heating equipment at your station at factory prices and wait for our pay while you test it during 60 days of winter weather.

The entire outfit **must satisfy you** or you pay nothing. Isn't this worth looking into? Could we offer such liberal terms if we didn't know that the **Hess Furnace** excels in service, simplicity, efficiency, economy?

We are makers—not dealers—and will save you all middlemens' profits. No room for more details here. Write today for **free** 48-page booklet which tells all about it.

Your name and address on a post card is sufficient.

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Your bed and table linen, plain clothes, flat pieces, 80 per cent of family wash, can be ironed **Easier** (no backache or tired feet), **Quicker** (in 1-5 the time), **Better,** with finish far superior to hand work, by using the

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1½ ct. per hour to heat by gas or gasoline. **Price within reach of all.** Sizes for small homes and large; operate by hand, or small washing machine motor. **Illustrated booklet** sent **free** on request. Write for our **30 day free trial offer** and nearest dealer.

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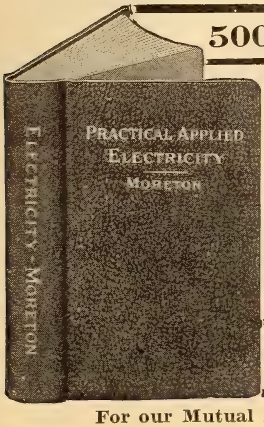

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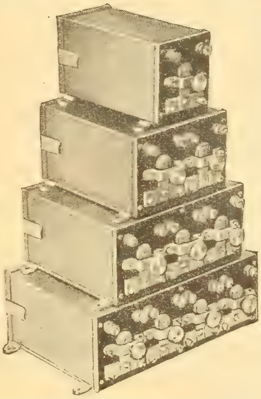
IN
Spark Coils

A Rare Opportunity to get a Remarkably Good Coil at a Ridiculously Low Price



We had on hand a large assortment of odd windings, vibrators, cases, etc., and quite a number of completed spark coils, which have been slightly used in shop experimental work. We have made up the parts into coils and have put the whole lot into good shape, tested them out, and now offer them at from 50% to 75% reduction. They are perfectly good—every one of them—but they're not new and we don't care to sell them as regular stock. THEY WON'T LAST LONG. Order at once. CASH MUST ACCOMPANY ORDER.

IGNITION COILS

Quantity		Sale Price
396	1-cyl. Box Coils, oak and birch finishes Regular price, ea. $4.45.....ea.	$1.50
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44	2-cyl. Box Coils Regular Price, ea. $8.25....ea.	3.00
63	2-cyl. Box Coils with covers Regular Price, ea. $8.75....ea.	3.50
10	3-cyl. Box Coils Regular Price, ea. $12.60....ea.	4.50
60	4-cyl. Box Coils with covers Regular Price, ea. $17.50....ea.	5.95
35	Cylindrical Metal Case Coils Regular Price, ea. $4.45....ea.	1.95

WIRELESS COILS

165	Good Wireless Coils. Spark length on factory tests, 3-8 inch to 1 inch. Well finished oak cases. Regularly sold at $3.00 to $6.00 all go at ea.	1.95

Send your order at once to Dept. B

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Wireless Receivers

Our long experience in manufacturing all kinds of receivers for telephone use, has made us specialists in WIRELESS RECEIVER work. Our special magnet steel, sensitiveness of operation, durable construction, places our wireless receiver set far ahead of anything manufactured in the country

Mention Popular Electricity when writing.

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FRENCH WOLLASTON WIRE

We have discovered a new Wollaston wire, made in France, which is far more sensitive and superior to the ordinary wire. This is not the only point in its favor; it will last longer and is far less expensive.

Price: Two Inches, 25 Cents; One Foot, $1.00.

WIRELESS DEALERS WRITE.

Send 3c. in stamps for large illustrated catalogue of Electrical and Wireless apparatus.

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Branch, Biloxi, Miss. 846 Ninth Ave., New York, N. Y.
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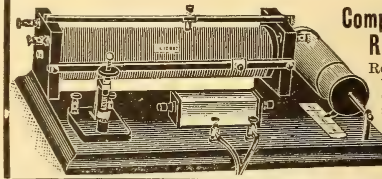

Complete Wireless Receiving Set

Reduced from **$12** to **$10** this month only. Send 3c stamp for catalog.

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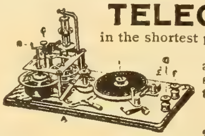

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in the shortest possible time. The Omnigragh Automatic Transmitter combined with standard key and sounder. Sends you telegraph messages at any speed just as an expert operator would. Five styles, $2 up; circular free.

OMNIGRAPH MFG. CO.
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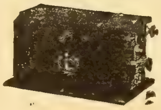

WIRELESS COILS

No. 1— 1-4 in. to 3-4 in. spark $3.50
No. 2— 3-4 in. to 1 1-4 in. spark 4.50
No. 3—1 1-2 in. to 2 1-2 in. spark 9.00

These high-grade guaranteed coils are not over-rated.

Send your money and coil will be shipped to you same day. Thousands of them in use.

LEMKE ELECTRIC CO., Dept. P. E., Milwaukee. Wis.

ATTENTION!!

On account of error made in using wrong electrotype in our ad. of March issue, we herewith repeat same, with correct illustration.

CAN YOU BEAT THIS?

2000 Ohm Leather Headband Set . . . $4.50

I SAY YOU CAN'T.

Better than anything on the market at this, and even at a higher price. Let us prove it.

Receiver only, 1000 ohms **$1.50**
Postage, ...10

C. BRANDES
111 Broadway, New York

Brooklyn Wireless "Mark of Quality" Be Wise

No. 8-14 Aluminum Aerial or Helix, or No. 14-22 Enameled Wires per pound	$0.50
No. 14-22 Bare Copper Wire per pound	.40
Stranded Galvanized Guy Wire per 100 feet, $0.35, Turn Buckles Each	.10
"Bwaenco" Universal Mineral Detectors Adjustable (for any Mineral)	1.00
"Bwaenco" Spark-Gap Adjustable, $0.35, Geissler-Tubes-3-inch Liquid"	.20
"Bwaenco" Non-Inductive-Potentiometer, $0.75, Potentiometer-Rods"	.15
"Bwaenco" Tuning Coils, Double Slide, $1.50, Single Slide	1.25
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"Bwaenco" 409-A-Variable "Tubular-Type-Seamless Brass Tubing	2.00
"Bwaenco" ½-K. W. Transformer with Fine Vibrator, $9.00; without Vibrator	6.50

BROOKLYN WIRELESS CO., 766 Broadway, Brooklyn, N. Y.

MURDOCK
Wireless Apparatus

The WM. J. MURDOCK CO. is prepared to furnish complete installations of the wireless telegraph for experimental or commercial purposes.

The correspondence of individuals or corporations contemplating either application of this mode of communication is solicited, and will receive careful and immediate attention.

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SECONDARY "UNITS"

Been having trouble winding your Secondary for your Induction Coil or Transformer? Why not put your worries on our shoulders? The winding is not a WORRY to us, as we have the equipment, and winding coils is a part of our BUSINESS.

Our Secondary "UNITS" are wood spool sections wound, parafined, etc., and all ready to connect up. You can buy a spool at a time or as many as you want, and they will cost you but little more than the wire alone,

Send 2-cent stamp for our large catalogue which tells all about it and many other things "WIRELESS" besides.

Dawson & Winger Electric Co.
429 Dearborn Street: Chicago, Ill.

ENAMEL INSULATED FRENCH Feval PROCESS **MAGNET WIRE**

ENAMEL WIRE is supplanting silk and cotton covered because **The Insulation is better,** because **It requires less space,** because **It is cheaper.**

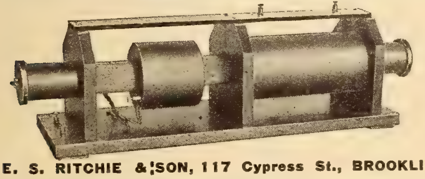
FEVAL WIRE has a dielectric strength in excess of 75 volts per .0001 inch of insulation. The evenly distributed enamel covering adheres tenaciously yet is resistant and elastic, never cracking. No change at 400° to 500° F. All sizes, Nos. 16 to 40.

MANUFACTURERS: We have an attractive contract proposal to offer covering your requirements for 12 months.

INDIVIDUALS: We will furnish small quantities for spark coils and magnets.

FEVAL ENAMEL INSULATED WIRE CO.
129 N. Curtis Street CHICAGO

WIRELESS TRANSFORMERS



1-2 K. W.
$30.00

Send for Catalogue

E. S. RITCHIE & SON, 117 Cypress St., BROOKLINE, MASS.

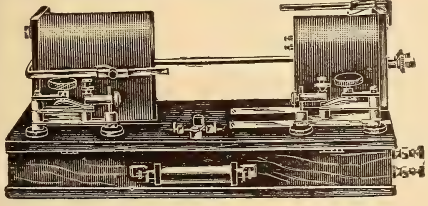
EVERYBODY CAN OWN A WIRELESS

We are this month offering an exceptional bargain in our new Wireless Receiving Set, consisting of combination **Electrolytic and Mineral Detector, Ohm Nickeled Receiver, 3 feet Silk Cord, 65 feet Aluminum Wire, and 8 Wiring Diagrams. 300 to 500 miles guaranteed. 2 inches of finest Wollaston Wire furnished. Price $1.40; postage 16c. extra.**

Send 3c. in stamps for large illustrated catalogue of Wireless and Electrical Specialties,

FRANKLIN ELECTRIC NOVELTY & MFG. CO.
Branch, Biloxi, Miss. 846 Ninth Ave., New York, N. Y.
LEVEY ELECTRIC CO., San Francisco, Cal., Western Agents.

High-Power Transmission Set, 1 K.W. to 25 K.W.



No. 6040, price - - $45.00
Complete Set, unmounted 32.00

BIG 200 Page Electrical Catalog
The Greatest Line of Wireless and Electrical Goods Extant

Send 4c stamp (to cover postage only) for this catalog, deducting same, if desired, from first order.

One of our patrons from California voluntarily writes as follows: "I think that it is only right for me to express my appreciation to you for the receiving set No. 6040 that you supplied me with some two weeks ago. I have never seen anything that can be compared to it. **I have received messages from stations sixteen hundred miles distant,**—on three occasions **I picked up Honolulu in the Hawaiian Islands** and heard signals very clearly," etc.

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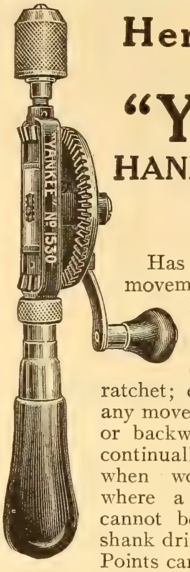
SCREW ANCHOR

To Fasten Electrical Fixtures

Push buttons, switches, lamp sockets, bells, switch boxes, and in fact all kinds of fixtures can be fastened more securely and with greater economy by the use of the **Sebco Screw Anchors.** To prove to you that they are best for fastening fixtures in brick, stone, tile or concrete, we will send you our free sample set, together with seventy page catalogue, No. 10.

STAR EXPANSION BOLT CO.
Catalogue Dept. 10
147 Cedar Street New York



Here's a Beauty

THE NEW

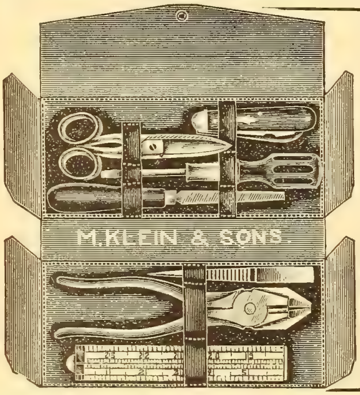
"YANKEE" HAND DRILL No. 1530

A Tool for Every Mechanic

Has the same unique ratchet movement used in our popular Breast Drills, the little slide between the gears changing it instantly from a plain drill to a right and left hand ratchet; or a double ratchet where any movement of the crank forward or backward causes the drill to cut continually. A great convenience when working at close quarters where a full revolution of crank cannot be obtained. Takes round shank drills 3-16" and smaller. Drill Points carried in the handle.

Send for Tool Book (Free)
TELLS ABOUT 35 STYLES 75 SIZES
Your dealer sells the "YANKEE."

NORTH BROS. MFG. CO.
Dept. C PHILADELPHIA, PA.


M. KLEIN & SONS.

Every Tool

in this Kit a first necessity to Mechanic Inspector, Lineman. In sight, in place, ready for action. Write for descriptive folder on Kit No. 403H.

Mathias Klein & Sons
Station U-3, Chicago

Star Hack Saw Blades

are highest in quality and lowest in price. These two features work well together. The blades which we are now turning out are the best we have ever made. You can satisfy yourself that this statement is no exaggeration by remitting to us 34c. for a sample dozen of 8-inch, or 42c. for 10-inch, or 50c. for 12-inch. Postage free.

MILLERS FALLS COMPANY
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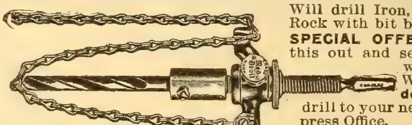
Schug Electrical Specialties

Spark Coils, Spark Plugs, Storage Batteries, Electric Lighting outfits.
BEST BY EVERY TEST
Send 4c postage for our illustrated catalog; free to dealers. Write us today.

SCHUG ELECTRIC MFG. CO.
Detroit, Mich. "Dept W."

Genuine "Red Devil" Self Feeding Chain Drill



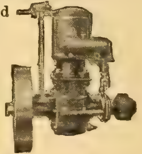
Will drill Iron, Steel or Rock with bit brace. **SPECIAL OFFER:**—Cut this out and send to us with $1.50. We will **deliver** this drill to your nearest Express Office.

Smith & Hemenway Co. New York City **150 Chambers Street**

"Runs Like A Scared Rabbit"

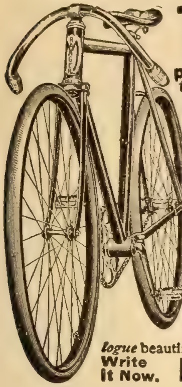
Writes Cleburne Grady, Montgomery, Ala., who while yet a green hand at motors averaged 12.92 miles per hour on a 8.62 mile river trip.

Perfection Marine Motor



The "Perfection" is so worthy of the name it needs little attention. Just a regular flow of gasoline and a good spark will keep it working on hard towing, ferrying or pleasure jaunts—and it will last as long as the boat. We build 2, 2½, 3½, 4, 6 and 8 H. P. in the single cylinder and 8 to 30 H. P. in the two, three and four-cylinder engines. Prices range from **$40** to **$450** according to type and horse power.

Write for catalog. **CAILLE PERFECTION MOTOR CO.,** 106 Caille St., Detroit, Mich.
Send for our Stationary Kerosene Engine Catalog if Interested



10 DAYS FREE TRIAL

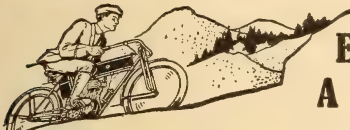
We will ship you a "RANGER" BICYCLE on approval, freight prepaid, to any place in the United States *without a cent deposit in advance*, and allow ten days free trial from the day you receive it. If it does not suit you in every way and is not all or more than we claim for it and a better bicycle than you can get anywhere else regardless of price, or if for any reason whatever you do not wish to keep it, ship it back to us at our expense for freight and you will *not be out one cent.*

LOW FACTORY PRICES We sell the highest grade bicycles direct from factory to rider at **lower prices** than any other house. We save you $10 to $25 middlemen's profit on every bicycle. Highest grade models with Puncture-Proof tires, Imported Roller chains, pedals, etc., at prices no higher than cheap mail order bicycles; also reliable medium grade models at **unheard of low prices.**

RIDER AGENTS WANTED in each town and district to ride and exhibit a sample 1911 "Ranger" Bicycle furnished by us. **You will be astonished** at the *wonderfully low Prices* and the liberal propositions and special offer we will give on the first 1911 sample going to your town. **Write at once** for our *special offer*. **DO NOT BUY** a **bicycle** or a pair of **tires** from *anyone at any price* until you receive our catalogue and learn our low prices and liberal terms. **BICYCLE DEALERS,** you can sell our bicycles under your own name plate at double our prices. Orders filled the day received. **SECOND HAND BICYCLES**—a limited number taken in trade by our Chicago retail stores will be closed out at once, at **$3 to $8 each.** Descriptive bargain list mailed free.

TIRES, COASTER-BRAKE rear wheels, inner tubes, lamps, cyclometers, parts, repairs and everything in the bicycle line at **half usual prices. DO NOT WAIT,** but write today for our *Large Catalogue* beautifully illustrated and containing a great fund of interesting matter and useful information. It only costs a postal to get everything.

Write it Now. **MEAD CYCLE CO. Dept. S-019 CHICAGO, ILL.**



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There is no limitation to the pleasure of motorcycling when you ride an

R. S. Motorcycle

"Built and Tested in the Mountains"

You can leave the zone of machine shops with a feeling of safety. You can climb hills that defy the ordinary motorcycle. A twist of the wrist and the **R. S.** immediately responds with any speed you dare ride. The **R. S.** is the only motorcycle in this country with a coaster brake and a foot brake. Make safety doubly sure. The **R. S.** has the simplest, coolest, surest, most powerful little motor ever produced. Most economical, silent and simple. Most comfortable. Most efficient spring seat post and shock absorber, and other exclusive and valuable features. Write for catalog. *Agents wanted.*

READING STANDARD COMPANY
Makers Renowned Reading Standard Bicycles
491 Water St., Reading, Pa.

R-S

PUNCTURES REPAIRED

BICYCLE TIRES

FREE

CLOVERLEAF BRAND FIXITFREE TIRES, are nearly perfection or we could not afford this guarantee; 99 per cent of the value in a tire cannot be seen, you cannot judge a tire by the looks; all look alike except the tread design, which has no value nor merit; only fancy. Wearing and puncture resisting qualities are what count. This is the service you are willing to pay for; TROUBLE SAVING, this is what we offer you. On usual guaranty you receive nothing in this direction, but unkept promises and "Hot Air"

Our Guaranty covers the unseen, the unknown parts; guarantees you the year's tire service WITHOUT EXTRA COST to you. All punctures and other repairs MADE FREE, or replaced with new tires, without charge, regardless of what or who is at fault. No questions, we simply do it. Local Dealers handling this brand of tires can do the same. INSURANCE TAG ATTACHED TO EACH TIRE This special introductory price now, Order early; give size wanted; Catalog Free.

Agents Wanted. **THE VIM** Chicago, Ill. Des Moines, Iowa Minneapolis, Minn.

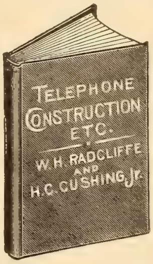
CLOVERLEAF BRAND

WE PAY EXPRESS

$5.85 PER PAIR **FIXIT FREE**

Mention Popular Electricity

TELEPHONE CONSTRUCTION INSTALLATION WIRING, OPERATION AND MAINTENANCE



By Radcliffe & Cushing

A practical reference book and guide for amateurs, electricians, wiremen and contractors, showing the principles of construction and operation of telephone instruments and improved methods of installing and wiring them.

Line wiring and the wiring of special telephone systems is also covered.

100 Pages 125 Illustrations

PRICE $1.00—POSTPAID

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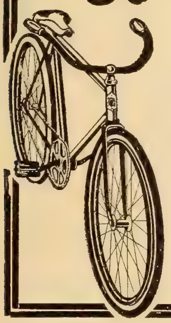


30 Days' Free Trial

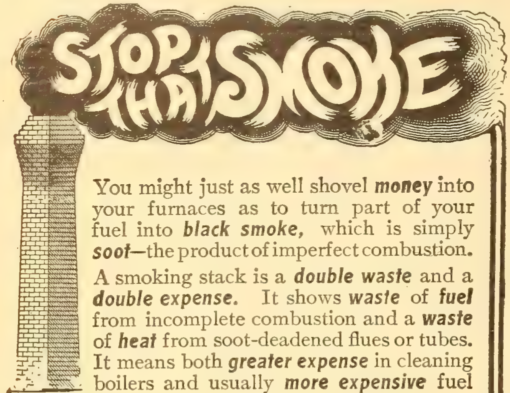
and if we haven't an agent in your city, we will sell you at **Wholesale Agents' Price** one

American Motorcycle or Bicycle

and prepay the freight. Hundreds of people will snap up this introducing proposition. The number of machines we sell on this liberal basis is limited—first come, first served. **Here is our plan:**—You ride the motorcycle or bicycle for 30 days. If it is not satisfactory, you may return it. If you like it, it's yours at the wholesale agents' price. **The American Motorcycles** are highest grade made, easy to start, simple to handle and powerful. You do not have to be a mechanic to run one. The American won the 1910 F. A. M. Western Endurance Contest, scoring 1000 per cent **perfect. The American Bicycles** are the best on the market. We give a **Life Guarantee.**

We have a money making proposition for live agents. Our enormous advertising campaign makes it easy to sell American machines Don't delay a moment. Our catalog and introducing offer will interest you; it's **free.** Write us which you want, motorcycle or bicycle. **Do it now.**

AMERICAN MOTOR CYCLE CO., 114 American Bldg., Chicago, Ill.



You might just as well shovel ***money*** into your furnaces as to turn part of your fuel into ***black smoke,*** which is simply ***soot***—the product of imperfect combustion. A smoking stack is a ***double waste*** and a ***double expense.*** It shows ***waste*** of ***fuel*** from incomplete combustion and a ***waste*** of ***heat*** from soot-deadened flues or tubes. It means both ***greater expense*** in cleaning boilers and usually ***more expensive*** fuel than would otherwise be efficient.

In short, whenever your chimneys smoke,

You are Burning Money

We absolutely guarantee ***The Scharf System*** to cut out ninety per cent of your smoke and to effect a saving in fuel cost. The Brookside Mills, of Knoxville, Tenn., writes:—"We have ***five*** 125 h. p. boilers equipped with ***five*** Scharf Smoke consumers and ***we know*** we are saving fuel and have reduced our smoke 90%."

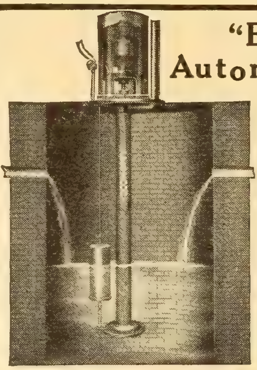
The Scharf System

The Only Automatic Smoke Preventing and Fuel Saving Device

Simple, reliable, safe and needs no attention. Gives perfect results while firing and all the time. Your engineer can install it, and without altering a single part of your boilers or shutting down the plant. Weighs but 100 lbs. complete. We sell it on an absolute guarantee. If you have several boilers, try it on one first. "Ten years ago we installed **two** Scharf Smoke Consumers," says the Marble & Shattuck Chair Co., of Cleveland, O., "and in 1907 a third one. With 300 h. p. capacity, our stack is **free from smoke."** There are in all **two** thousand of our machines in use to-day.

WRITE US for our proposition and new catalog. Tell us (without obligation) how many tons of coal you burn each day, at what cost, how many boilers and what h. p. each. We will tell you what we can save you.

THE G. H. SCHARF COMPANY
68 Huron St., Ypsilanti, Mich.



"ECONOMY" Automatic Electric Protected Type Bilge Pumps

are especially designed for automatically pumping all seepage, drainage and sewage water out of basements, keeping them dry, useful and sanitary.

Are designed to work automatically and require no care aside from an occasional oiling.

The Automatic Switch which starts and stops the motor is of simple construction, having no weights, air valves, fulcrums or other apparatus easy to get out of order, and is controlled by a position float.

The motor is of standard make especially adapted for this peculiar service.

The pump is the centrifugal type, having no gears, cams, belts or valves to get out of order.

The pump is always below the water level.

The motor and switch are protected by a heat radiating hood, which eliminates any danger of the motor being damaged by moisture and which allows for a forced circulation of air.

We also manufacture: Automatic Water Systems, Sewerage Ejectors, Condensation Pumps and Receiver, Cellar Drainers, Centrifugal and Plunger Pumps, Hot Air Engines, Vacuum Cleaning Apparatus, Air Washers, Purifiers and Cooling Apparatus. Watch for our ads. telling you all about them.

THOMAS & SMITH, Inc. 116-118 N. Carpenter St., CHICAGO
416 Broadway, NEW YORK

Thank You, Gentlemen

You DID respond to our full page ad in the last issue—splendidly.

Now, let me tell you something:

Kimble Motors

Are the only **A. C. Motors** that give you a large variasion in speed on single phase. **One Lever** on the motor stops, starts, reverses and controls speed up or down, and no resistance, starting, compensating or any other outside controlling device is necessary.

This single phase Motor also operates on 2 phase or 3 phase circuits.

It puts **all the current you pay for** to **useful use** —consuming none in reducers or other wasteful devices, and it requires no more current to **start** a Kimble Motor than it does for full load running.

The Kimble A. C. Motors are the best of all motors for any machinery that calls for an approximately even, continuous load—like printing presses, pipe organs, ice cream freezers, sewing and washing machines, etc.; but are not adapted to variable intermittent loads, like lathes, drills, etc.

Kimble Single Phase Variable Speed reversible A. C. Motors are made in 1/6, 1/4, 1/3 1/2, 3/4, 1, 1 1/2 and 2 H. P. sizes—110 and 220 volts, 25 to 60 cycles.

Send for price list and guarantee on our Single Phase, as well as our Polyphase Constant and Variable Speed Motors made up to 10 H. P.

JAS. K. BASS, General Manager

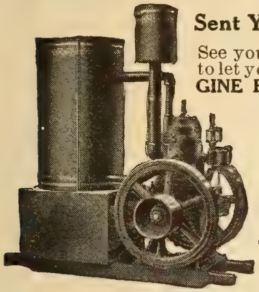
KIMBLE ELECTRIC COMPANY
1119 Washington Blvd. Chicago, Ills.

This Kerosene Engine Cuts Your Expenses 75%

YOU should not even consider engines that operate on gasoline only. The rapidly rising price of gasoline, now 6 to 16 cents higher than kerosene, absolutely makes operation on this fuel too expensive. The Perfection Kerosene Engine operates on **any** engine fuel. When you purchase it you are on the safe side—proof against all fluctuations of the market. You can always run this engine at a great fuel saving and get the greatest amount of work done. The Perfection **vaporizes its own kerosene** and so makes it as efficient as gasoline—something other engines **cannot** do.

The Perfection is very light, portable, has only three moving parts, runs everything about the place, is lower in price than any other engine of its capacity on the market.

PERFECTION Kerosene Engine



Sent You on 15 Days Free Trial

See your dealer at once and ask him to let you have a copy of our **Free ENGINE BOOK,** which shows the sizes and styles of the "Perfection" and explains this very attractive offer. Your dealer will send any "perfection" engine to your farm for 15 days and let you return it if you are not satisfied. Ask him about it. If he does not carry the "Perfection" write to us and we will send you our **Free Engine Book** direct.

CAILLE PERFECTION MOTOR CO.

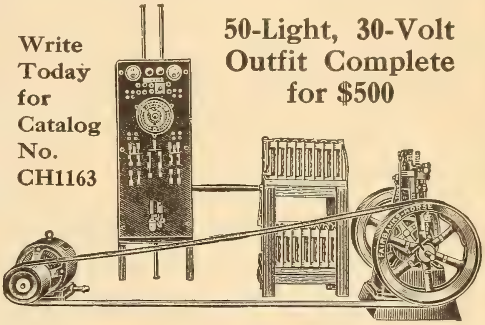
202 Second Ave., Detroit, Mich.

You Can Have Electric Lights

in your home, no matter where you live, at the small cost of generating the current. Our complete outfits are easy to install and to care for. They furnish a light of great brilliancy—the most convenient and healthful light known. Same engine can be used for operating a water supply system or other machinery. The outfit can be used to run electric motors for driving pumps, fans, sewing machines, etc. Outfit will last for years at a very small maintenance cost. We also make larger electric light plants up to 500 H. P. in single units.

Write Today for Catalog No. CH1163

50-Light, 30-Volt Outfit Complete for $500



Fairbanks, Morse & Co.

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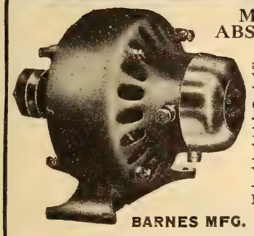
1/12 AND 1/8 Direct and Alternating Current Motors
VARIABLE SPEED - SINGLE PHASE

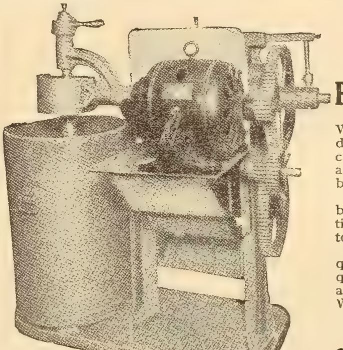


MOTORS THAT WILL ABSOLUTELY NOT HEAT

'The Barnes Motors" are especially adapted for Washing Machines, Vacuum Cleaners, Air Purifiers, Ventilating Devices, Coffee Mills, Meat Choppers, Printing Presses, etc., etc. —Dental and Medical work a specialty. Positively the best motor for use where motor driven work is necessary —greatest power, highest efficiency We want Reliable Agents everywhere —write at once for prices and catalog. Let us figure on your requirements.

BARNES MFG. CO., SUSQUEHANNA, PA.

The Dewsberry ELECTRIC Power Freezer



Will enable you to produce a better grade of ice cream at a lower price and in less time than by any other method.

These machines are built unusually substantial, and are guaranteed to give satisfaction.

Made in 20 and 40 quart sizes. The 40 quart size runs both fast and slow on A.C. current Write to-day for circular

R. A. Dewsberry

216 N. Morgan St. CHICAGO.

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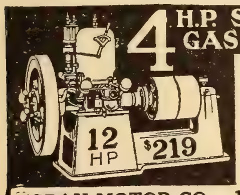
4 H.P. STATIONARY GASOLINE ENGINE COMPLETE $76.00



For Farmwork, Irrigation or Pumping, Factory use and Electric Lighting.

3 to 20 h.p.—perfectly governed—guaranteed by a responsible firm. Write for full description.

GRAY MOTOR CO., 128 Leib St., DETROIT, MICH.

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2 H.P. Gasoline Engine $36.00

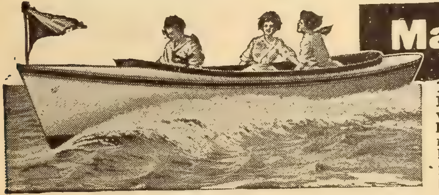
With Complete Equipment

4 H. P. Water Cooled	$64.00
3 H. P. Air Cooled	78.50

A full line of Portable and Marine Engines in all sizes, at the same extremely low prices. Brand new and guaranteed strictly high grade. 30 days free trial, or money back if not satisfactory.

Enormous stock of Electrical supplies, Shafting, Hangers, Pulleys, Belting, everything in the line of machinery at a saving to you from 30 to 75 per cent. Write us your wants.

Chicago House Wrecking Co., Chicago



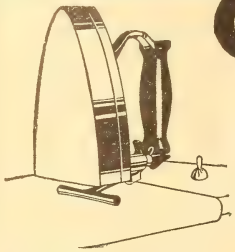
Magnificent Steel Launch $96
Complete With Engine, Ready to Run

18-20-23 and 27 ft. boats at proportionate prices. All launches tested and fitted with Detroit two-cycle reversible engines with speed controlling lever—simplest engine made—starts without cranking—has only 3 moving parts—anyone can run it. **The Safe Launch**—absolutely non-sinkable—needs no boathouse. All boats fitted with air-tight compartments—cannot sink, leak or rust. We are sole owners of the patents for the manufacture of rolled steel, lock-seamed steel boats. Orders filled the day they are received. Boats shipped to every part of the world. **Free Catalog. Steel Rowboats, $20.**

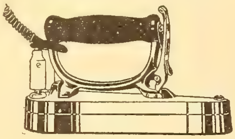
MICHIGAN STEEL BOAT CO., 1366 **Jefferson Avenue, Detroit, Mich., U. S. A.**

CUTLER-HAMMER

ELECTRIC HEATING DEVICES



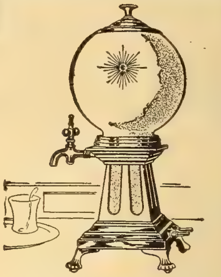
Household Iron—5, 6, 7 lbs.
No separate stand required



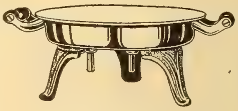
Sleeve Iron—3 lb.
Detachable Handle
Convenient for travelers

Turn on the switch of a Cutler-Hammer Portable Water Heater and in 45 seconds you will have steaming hot water for tea, malted milk, lemonade, a hot "toddie" or for medicinal or other purposes.

Cutler-Hammer Electric Irons have uniformly heated ironing surfaces and unusual heat retaining qualities. The small sleeve iron is 2 1-4 inches at its widest part. It is especially adapted for ironing fancy laces, doilies, etc.



Portable Water Heater
3-qt. size—Hot water, 45 sec.



A Disc Stove
Has quickly heated 7-in.
surface

The Disc Stove can be used for numerous uses in the kitchen, dining room and bed room. It is finished in polished nickel.

Our entire line is illustrated and described in a 32-page booklet. Copy sent free on request.

The Cutler-Hammer Mfg. Co. Milwaukee. Wis.

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CLEVELAND: 1329 Schofield Bldg.
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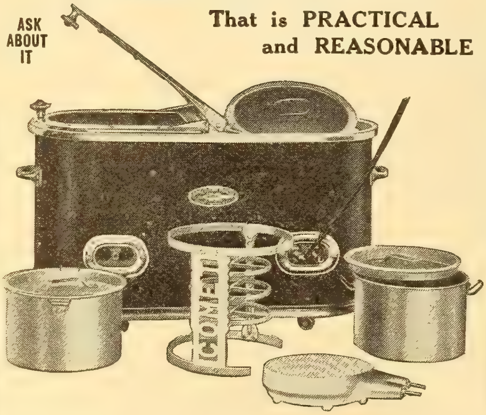
PITTSBURG: Farmers' Bank Bldg.
PHILADELPHIA: 1201 Chestnut St.
PACIFIC COAST AGENTS: OTIS & SQUIRES
155 New Montgomery St., San Francisco

COMET ELECTRIC STOVE

A REAL FIRELESS COOKER

ASK ABOUT IT

That is PRACTICAL and REASONABLE



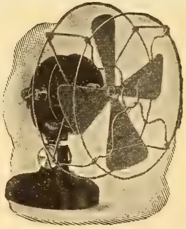
The Comet Electric Stove is designed to save fuel. Cheaper than gas, coal or wood, no odor, dust or smoke.

Reasonable to buy—convenient to use—economical for the Home, Camp, Motor Boat, or Automobile. You don't have to depend on electricity alone—it's a fireless cooker as well.

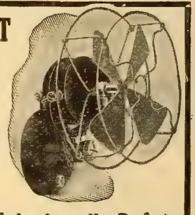
Ask us more about it now—today. Special prices to Central Stations and Dealers.

COMET ELECTRIC STOVE CO.

280-284 Eighteenth Street DETROIT, MICH.



A PERFECT 110 VOLT FAN FOR $6.50



Electrically, Mechanically and Aesthetically Perfect.

Finish, black enamel and nickel. For home and office, telephone booth, picture show, or in any place where a ceiling fan is not needed. As **good as any fan at any price.** Desk or bracket. Noiseless and sparkless. Strong breeze—6 in. blades. Say whether for alternating or direct current, and give dealer's name. We PREPAY EXPRESS and guarantee satisfaction.

Seven volt battery fan at same price.

The Carleton Company 178 Summer St., Boston, Mass.

"Domestic" Electric Washer and Wringer

Oscillating, Self Cleaning, All Metal Tub, Reversible, Metal Frame Wringer, Positive Drive, Automatic Belt Tightener, Inclosed Working Parts. No Springs to Break.

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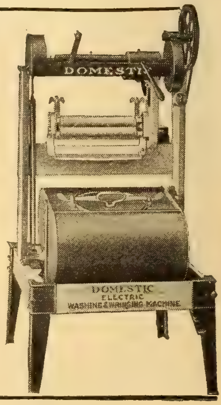
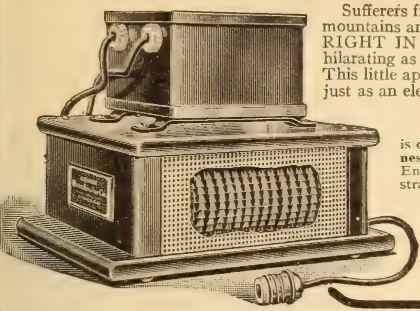
53 State St., Chicago



Let Electricity Make Pure Air for You



Sufferer's from many ailments travel thousands of miles to breathe the OZONE of the mountains and pine forests. Yet a recent scientific invention enables everyone to have—RIGHT IN THEIR OWN BEDROOM—air constantly as pure, refreshing and exhilarating as the purest oxygen-filled atmosphere of the piny woods and mountain peaks. This little apparatus is operated by electricity and "ozonizes" the air of the closest room just as an electric storm purifies the out-door air. The

OZONE PURE AIRIFIER

is of greatest benefit in the treatment of **Asthma, Hay Fever, Catarrh, Insomnia, Nervousness, Pneumonia, Typhoid and Scarlet Fevers, Diphtheria, Bronchitis, Tuberculosis, etc.** Endorsed by highest medical and scientific authoritiesa thoroughly tested and demonstrated success.

Central Station. Electric Jobber and Dealer, this is the latest Electrical Appliance on the market. Write now for illustrated catalogue, price list and descriptive matter and plan of placing for liberal trial.

We want distribution throughout the United States in Every Place Where Electrical Appliances are Sold.

OZONE PURE AIRIFIER COMPANY
307-314 Rand McNally Bldg. CHICAGO, ILL.

Every Hostess

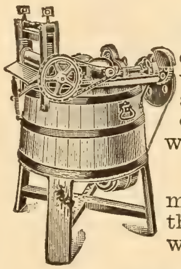
appreciates the dainty convenience of the Simplex Electric Percolator—those who have made coffee with a Simplex percolator know that such delicious coffee connot be made as readily and easily on the table by any other method. Catalog of other styles as well as other Simplex Household Helps sent on request—or ask to see Simplex devices at your lighting Company's or dealers.

Simplex Electric Heating Co.
CAMBRIDGE, MASS.

CHICAGO
Monadnock Block

SAN FRANCISCO
612 Howard St.

Back Gears Save Power Enough to Pay For It



The back gear drive of the Elmo Power Washer enables it to do a big washing with the same amount of power that ordinarly does a small washing.

It is like the muscular man who does twice or three times the work of a weak man.

The Elmo

has also a positive action wringer, an easy-opening lid, a protected motor. It is noiseless, strongly built, has cypress tub good for fifty years use, and will do a week's wash at an average cost of 1c. for power.

Write for booklet that tells the whole story of Elmo supremacy.

Grinnell Washing Machine Co.
Grinnell, Ia.

Canadian Trade Supplied by the Gem Motor Co.,
419 Portage Ave., Winnipeg, Man.

TO BE CLEAN

YOU NEED

The "BEE" Suction Cleaner

IT

costs only $65.00 with complete equipment.
weighs only 20 lbs. No Jar or Vibration.
equals the highest priced machines in efficiency.
does the best work with the least effort.
has NEW and EXCLUSIVE FEATURES.

SOLD ONLY BY RELIABLE AGENTS.

BIRTMAN ELECTRIC CO., CHICAGO, U. S. A.

Our new catalog

supplemented by specific information regarding the work of the Edison in various fields. such as electric commercial and pleasure vehicle propulsion, ignition of gasoline cars and motor boats, and electric lighting of motor cars. motor boats, yachts, houseboats and country homes, covers the entire subject of construction, performance and use of

The Edison Storage Battery

No matter for what use you require storage batteries, you should have the definite information regarding the Edison as compared with other storage batteries, which this new Edison Catalog contains—together with the specialized data for your particular field of work.

No matter how disappointing your previous experience with storage batteries has been—for whatever purpose — your appreciation of the Edison will be all the greater.

The Edison is not merely an improvement on other storage batteries. It is an absolutely new departure—radically different in every respect. The result is a battery of about double the capacity of a lead battery of equal weight; a battery that is not subject to any of the ills of the lead battery, that will stand the roughest treatment, that requires only a fraction of the care and and attention of the lead battery and that lasts many times as long.

In writing for the new catalog, state the field in which you are interested and additional information will be sent to you with it.

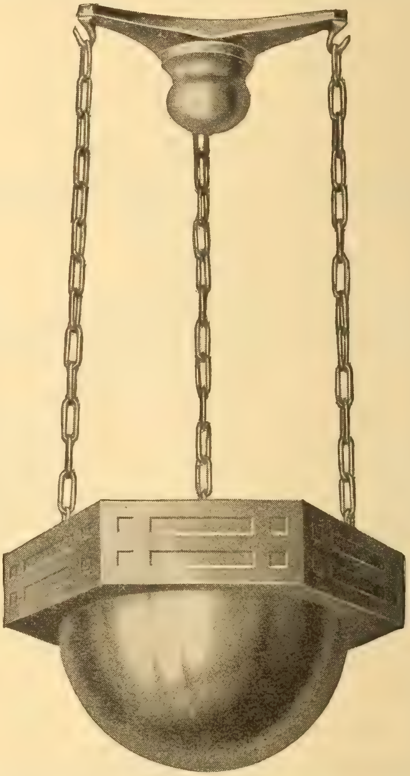
Edison Storage Battery Company
117 Lakeside Ave., Orange, N. Y.

At Last

It is possible to secure comfortable, even light throughout a room without a brilliant light in range of vision.

The Eye Comfort System of Indirect Illumination is the notable succession in the lighting field.

Installations are being made in all sections of the country.



¶ Residences
¶ Offices
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¶ Hotels
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¶ Theatres
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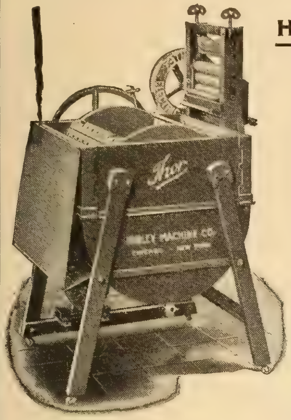
¶ Etc., etc.

¶ While we sell through the electrical trade only, our Engineering Department solves free of charge your lighting problem if you will but send details of interior.

¶ Originators and sole producers of the first and only scientifically designed reflectors and appliances which make indirect illumination possible.

¶ Write today for full particulars.

National X-Ray Reflector Co.
257 Jackson Boulevard Chicago, Illinois



The THOR Electric Home Laundry Machine

HAS NO EQUAL

for
Efficiency
Durability
Simplicity
and
Low Cost of operation

Made in different sizes and materials adapted for any house or apartment.

Not to know all about the **THOR Electric** means a direct loss to you.

Sold for Cash or on Monthly Payments
Send for Free Booklet 50

HURLEY MACHINE COMPANY
1010 Flat Iron Bldg. New York
37 S. Clinton Street Chicago

Let Us Send You This

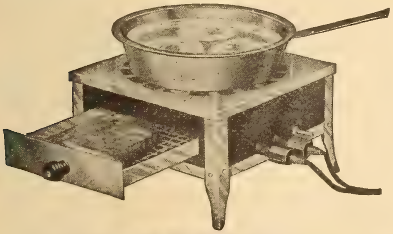
EUREKA Electric Cleaner

On Free Trial
Then if you like it the price is only $35 delivered —If not, the Trial Costs You Nothing

Any broom, brush, cloth or other dry cleaner that does not suck in every particle of dust it raises is not only unclean, but unhealthful. No other indoor dry method of cleaning than suction can make your house **really clean.** The **EUREKA** cleans floors, rugs, carpets, etc., and our extra attachments clean portiers, walls, furniture—everything. **Quickly pays for itself.** Electricity used costs less than one cent per hour. So light a child can use it, yet we guarantee it to clean faster, better and with less effort than any other cleaner, regardless of cost.

Will you let us prove this broad claim at our own expense? If you have electric lights, write today for booklet and full particulars of our **FREE TRIAL OFFER.**

EUREKA VACUUM CLEANER CO.
1233 MAJESTIC BLDG. DETROIT, MICH.
REAL AGENTS WANTED



Cadillac Combination Electric Stove and Toaster

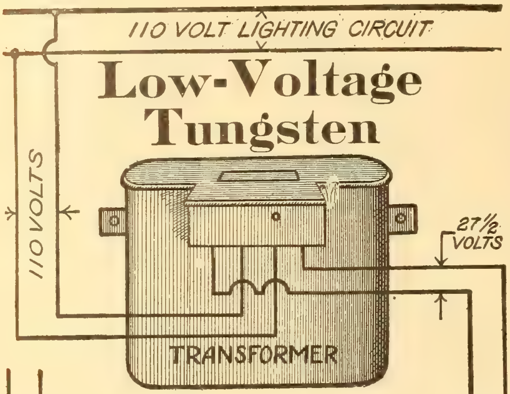
Prepares Eggs, Coffee or Chops and at the Same Time Toasts in the Drawer Below

Three different degrees of heat are instantly available—high, medium and low—for fast cooking, slow cooking or simply keeping things warm. No special wiring is required as it operates from the ordinary light socket. Guaranteed against burn-outs for one year and can be instantly repaired by an inexperienced child.

The *Cadillac Combination Stove and Toaster* may be had from the better class of electrical dealers for *Seven Dollars and Fifty Cents.*

MADE BY THE

CADILLAC ELECTRIC MANUFACTURING CO.
16 MITCHELL STREET CADILLAC, MICHIGAN



Low-Voltage Tungsten

Agent's Make Big Money

Selling Warner Low Voltage Tungsten Lighting Outfits

¶ As applied to the use of the **Tungsten** lamp, **Low Voltage** stands for LONG LIFE as well as efficiency. The lower the voltage the safer it becomes, both to life and property.

¶ The insulation of the extra transformer is quite an added factor of SAFETY—Safety from danger of fires and short-circuits, from lightning, from electric shocks.

¶ 27½ volts, (the standard voltage adopted by us) is absolutely harmless, even the most sensitive person can scarcely feel the current at this voltage.

¶ Low Voltage Tungsten Lamps have a SHORT-Heavy filament, which withstand shocks and vibration very much the same as the carbon lamp, and yet they make three times as much light as the carbon lamp on the same current.

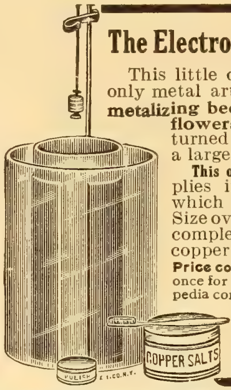
¶ Our bulletin 600-P tells more about this wonderful "money-saving-system." It is yours for the asking.

Warner Arc Lamp Co.

Davenport, Ia.

27½ Volt Lamps

27½ Volt Lamps



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This little outfit will copper plate not only metal articles, but is also used for **metalizing beetles, insects, nuts, fruits, flowers, etc.,** all of which can be turned out to perfection. There is a large demand for such goods. **This outfit needs no batteries,** but supplies its own current, something which no other outfit can do. Size over all, 13 x 5¼ inches, weight complete, 3½ pounds; comes with copper plating salts ready for use. **Price complete, $1.25.** Send 4c postage at once for our great 196-page Electrical Cyclopedia containing 400 illustrations.

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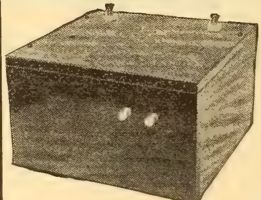

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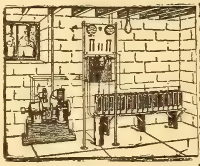

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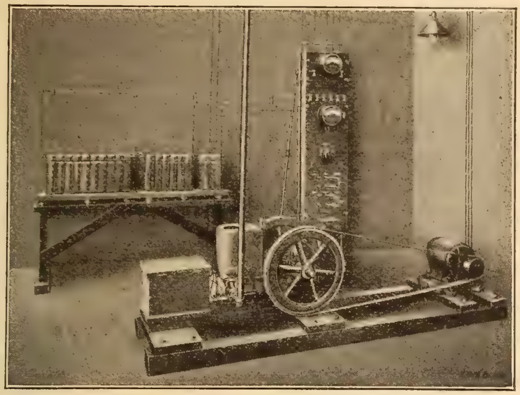

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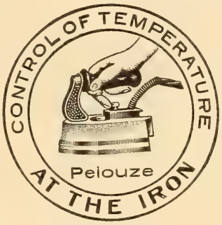

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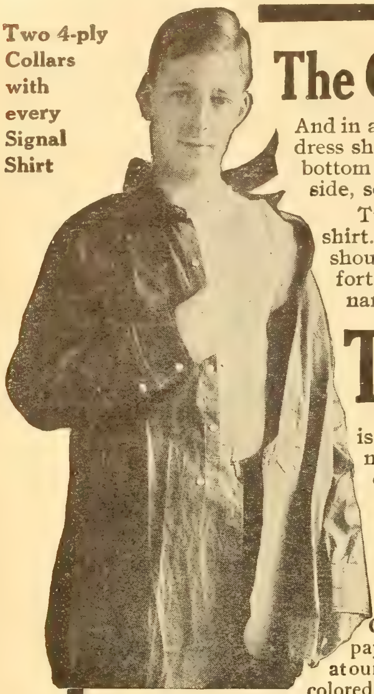

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And in addition, furnished with advantages that even the high priced dress shirts don't have—exclusive comfort features, like extra button at bottom of breast plait, to improve fit; extra full skirts, sleeve-slit in side, so it keeps out dirt—can't gap.

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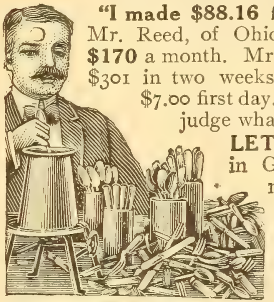

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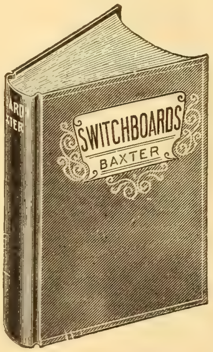

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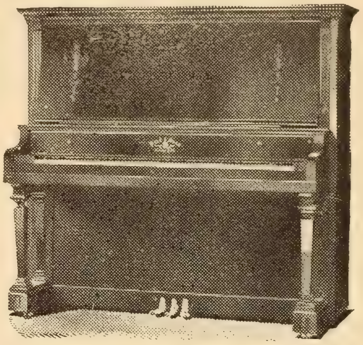

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Made in three types and sizes for different classes of work and so neat in appearance that they can be installed anywhere in homes, hotels, offices, schools, hospitals, etc.

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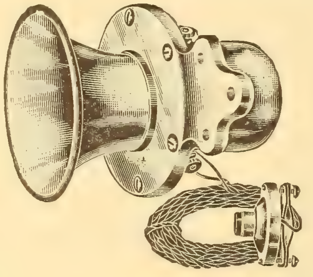

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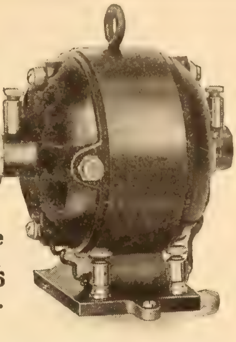

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Runs on a. c. and d. c. current, 110 *volts. Includes complete set of blue prints showing how to assemble. Has laminated field and armature, mica insulated commutator,* 3-16 *carbon brushes, bronze bearings, brass grease cups, pulley and terminals.*

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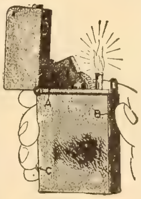

Combination Pocket Light and Cigar Lighter. The best metallic friction spark lighter on the market. Will last a lifetime. Press the button, the lid springs up, and the sparks from the "Ceric-Iron" pill ignite the wick. Unscrew valve and fill with 40 drops benzine, gasoline or alcohol, which will last 8 days. Benzine preferred. Regular price $1.50.

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Nickel Tungsten Flashlight, with (new process) Merchlor Battery, and enameled Tungsten Bulb.

Price by mail, postpaid	95c
In silver finish	$1.35
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Air now burned in this wonderful stove is free to rich and poor alike. No trust in control.

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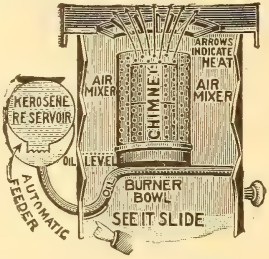

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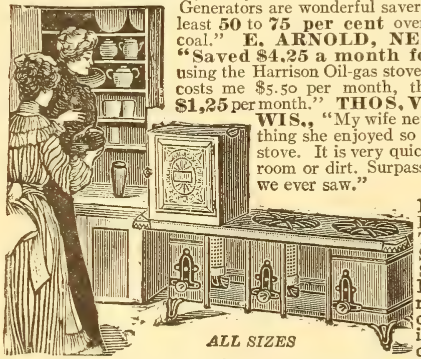
Scientific test proves it uses **395 barrels of air** to **one gallon** common kerosene oil.

CHEAPEST FUEL—SUMMER COMFORT. Intense heat but **concentrated** under cooking vessels and absorbed by articles being cooked—not thrown out to **overheat** your kitchen.

To operate—turn knob—oil runs into burner—touch a match; it generates gas, which passes through air mixer, drawing in about a barrel of air to every large spoonful of oil consumed. **That's all.** It is self-regulating, no more attention. Same heat all day or all night. For more or less heat, simply turn knob. There it remains until you come again. To put fire out, turn knob, raising burner—oil runs back into can, fire's out. As near perfection as anything in this world. **Ideal for summer use.** Not dangerous like gasolene. No dirt, soot or ashes. No leaks—nothing to clog or close up. No wick—not even a valve, yet heat is under perfect control—**kitchen always cool. D. CARN, IND.,** writes: "It costs me only **4 1-2 cents a day for fuel," L. NORRIS, VT.,** writes: "The Harrison Oil-Gas Generators are wonderful savers of fuel, at least **50 to 75 per cent** over wood and coal." **E. ARNOLD, NEB.,** writes: **"Saved $4.25 a month for fuel** by using the Harrison Oil-gas stove. My range costs me $5.50 per month, the Harrison **$1.25** per month." **THOS. VINCENT, WIS.,** "My wife never had anything she enjoyed so much as her stove. It is very quick, no heated room or dirt. Surpasses anything we ever saw."



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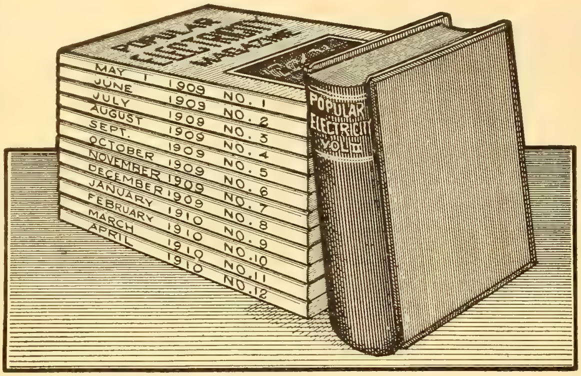

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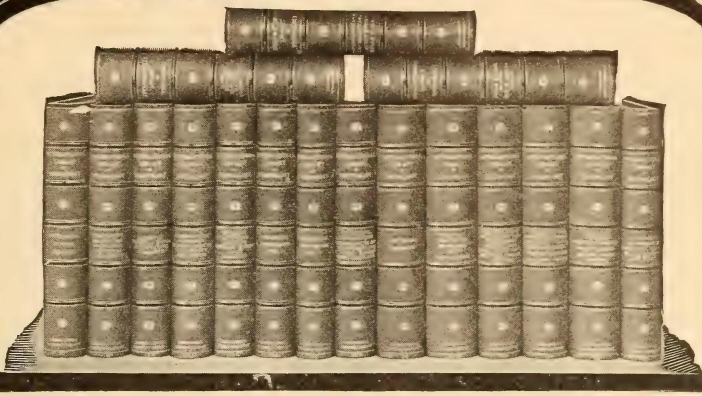

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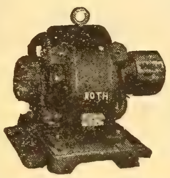

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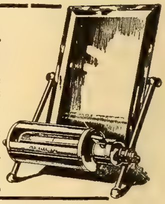

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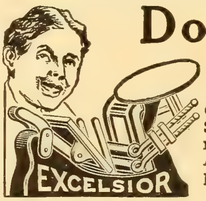

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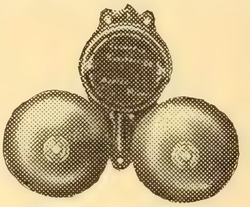

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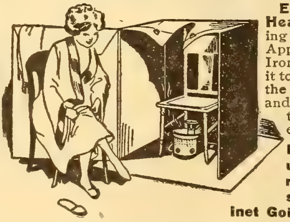

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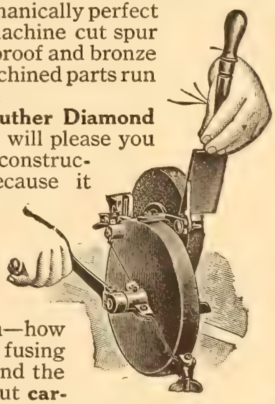

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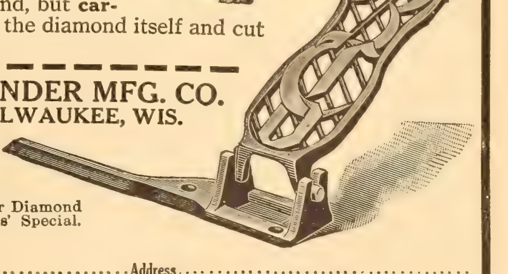
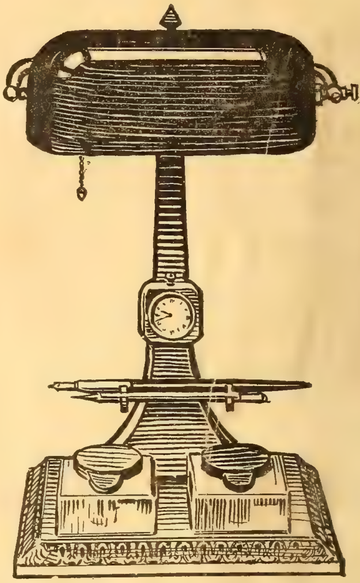
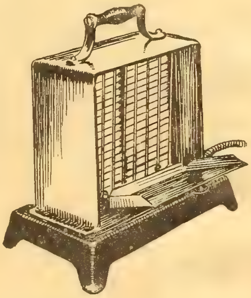


An Ideal Lamp for the Office Desk



This is a very popular lamp because it combines, at a moderate price, the utmost practicality with a very pleasing appearance. The standard is in Statuary Bronze, with green relief. Its base, 7 x 9 1-2 in., contains two ink-wells. A pen-rack and a watch (a good time keeper) are attached to standard. The shade is of green plated-glass outside, with white opal glass inside. The lamp lights an area 48 in. wide by 36 in. in front of base. Complete with 6 foot silk connecting cord and plug, price $18, f. o. b. Chicago.



To Make Delicious Toast At the Table

The Electric Toaster is intended for use on the dining table. It toasts bread, two slices at a time, as fast as required for three or four persons. The toast comes out piping hot, crisp and brown outside, tender inside. The cost for electricity is about one cent per dozen slices. Price complete with connecting cord, $4.80 f. o. b. Chicago. (See foot-note below.)

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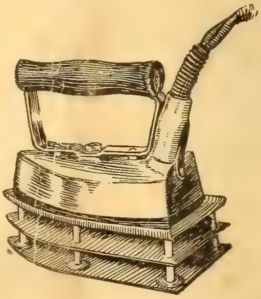

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